World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(RESEARCH ARTICLE)

Check for updates

Pollutants and climatic conditions related to the childhood asthma and atopic dermatitis

Shigeru Suna *

Private Health Research Laboratory, 14-22 Shinkita-machi, Takamatsu-shi, Kagawa 760-0001, Japan.

World Journal of Biology Pharmacy and Health Sciences, 2022, 09(01), 027–038

Publication history: Received on 12 December 2021; revised on 19 January 2022; accepted on 21 January 2022

Article DOI: https://doi.org/10.30574/wjbphs.2022.9.1.0025

Abstract

Indoor, outdoor pollutants and climatic conditions in the growing environment can develop childhood asthma and atopic dermatitis. Therefore, it is important to identify the environmental burden of the community on the risk of childhood asthma and atopic dermatitis.

To clarify the relationship between regional prevalence rate of childhood asthma and atopic dermatitis among the first grade elementary school students and preschool indoor and outdoor conditions such as smoking rate, photochemical oxidants concentration, ambient temperature and relative humidity, multiple linear regression analysis was performed.

Stepwise multiple regression analysis with asthma rate as the objective variable, atopic dermatitis rate, smoking rate, photochemical oxidants, ambient temperature and relative humidity as explanatory variables, revealed that atopic dermatitis rate and smoking rate were significant independent variables. This result suggests that tobacco smoke is a risk factor for non-atopic asthma rather than atopic asthma.

Stepwise multiple regression analysis with atopic dermatitis rate among first grade elementary school students as the objective variable, smoking rate, photochemical oxidants, ambient temperature and relative humidity as explanatory variables, revealed that photochemical oxidants and ambient temperature were significant independent variable.

Present study suggests that preschool indoor and outdoor conditions such as environmental tobacco smoke, photochemical oxidants, and ambient temperature may be associated with the development of childhood asthma and atopic dermatitis.

Keywords: Childhood asthma; Atopic dermatitis; Smoking rate; Photochemical oxidants; Ambient temperature; Relative humidity

1. Introduction

Indoor, outdoor pollutants and climatic conditions in the growing environment can develop childhood asthma and atopic dermatitis [1-7]. Therefore, it is important to identify the environmental burden of the community on the risk of childhood asthma and atopic dermatitis.

The aim of this study is to clarify the relationship between the regional prevalence rate of childhood asthma and atopic dermatitis among the first grade of elementary school students in Japan and the preschool environmental conditions such as smoking rate, photochemical oxidants concentration, ambient temperature and relative humidity.

* Corresponding author: Shigeru Suna
Private Health Research Laboratory, 14-22 Shinkita-machi, Takamatsu-shi, Kagawa 760-0001, Japan.

2. Material and methods

2.1. Prevalence rate of childhood asthma and atopic dermatitis

Prefectural prevalence rate of childhood asthma and atopic dermatitis among the first grade of elementary school were from School Health Statistics Survey by the Ministry of Education, Culture, Sports, Science and Technology (https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00400002&tstat=000001011648).

2.2. Air pollutants

Smoking rate by prefecture, as an indicator of regional indoor air pollution was obtained from Cancer Information Service, National Cancer Center, Japan.

(https://ganjoho.jp/reg_stat/statistics/dl/index.html#smoking). The smoking rate is the ratio of the total number of people (men and women over 20 years old) who answered "smoking daily" or "sometimes smoked" as a numerator and the "total number of respondents" as a denominator.

The annual average value of prefectural photochemical oxidants concentration was obtained from National Institute for Environmental Studies.

(https://tenbou.nies.go.jp/gis/monitor/?map_mode=jpn_env_atmosphere)

2.3. Climatic conditions

The annual average values of relative humidity and ambient temperature by prefecture were from Social Indicators by Prefecture. The values were downloaded from e-Stat (https://www.e-stat.go.jp/dbview?sid=0000010102).

2.4. Statistical analysis

Stepwise multiple linear regression analysis was performed to determine the relationship between prevalence rate of childhood asthma and atopic dermatitis and preschool environmental conditions. $p < 0.05$ was considered as statistically significant. The first investigation was for first grade elementary school students from 2008 to 2010, and the second was for first grade elementary school students from 2017 to 2019.

3. Results

3.1. Prevalence rate of childhood asthma and atopic dermatitis

Table 1and 2 show percentage of asthma among first grade elementary school students from 2008 to 2010 and from 2017 to 2019. Table 3 and Table 4 shows percentage of atopic dermatitis among first grade elementary school students from 2008 to 2010 and from 2017 to 2019.

Table 1 Prevalence rate of asthma among first grade elementary school students from 2008 to 2010

Prefecture	Asthma (%)			Prefecture	Asthma (%)		
	2008	2009	2010		2008	2009	2010
Hokkaido	2.6	4.1	2.5	Shiga	2.9	1.7	3.2
Aomori	2.6	2.5	2.1	Kyoto	3.6	3.3	4.5
Iwate	3.8	2.0	3.9	Osaka	3.4	4.4	3.9
Miyagi	6.4	5.9	6.8	Hyogo	3.8	2.7	3.0
Akita	5.3	4.1	6.5	Nara	1.1	1.6	1.2
Yamagata	4.5	3.5	6.3	Wakayama	1.1	1.5	1.7
Fukushima	3.5	3.3	3.1	Tottori	7.5	7.9	8.3
Ibaraki	4.8	4.1	7.3	Shimane	4.3	5.6	6.3

Tochigi	3.0	4.1	5.1	Okayama	3.9	3.5	6.5
Gunma	5.1	4.7	4.2	Hiroshima	3.4	4.1	3.8
Saitama	4.1	3.9	6.0	Yamaguchi	3.2	3.3	5.1
Chiba	5.7	4.8	5.6	Tokushima	4.0	4.1	3.8
Tokyo	6.6	7.0	6.6	Kagawa	4.4	2.1	4.5
Kanagawa	5.4	3.5	5.9	Ehime	3.1	2.9	2.9
Niigata	7.5	6.2	7.9	Kochi	3.0	2.9	3.3
Toyama	3.8	2.3	5.9	Fukuoka	2.7	2.0	4.2
Ishikawa	2.0	2.1	3.1	Saga	1.9	1.2	3.5
Fukui	5.3	3.2	5.1	Nagasaki	2.7	2.0	2.7
Yamanashi	4.4	3.3	4.5	Kumamoto	2.8	1.8	2.8
Nagano	4.8	4.7	7.3	Oita	1.1	1.9	2.7
Gifu	2.9	2.1	2.4	Miyazaki	3.2	2.2	3.3
Shizuoka	5.0	3.5	3.6	Kagoshima	2.5	1.7	2.3
Aichi	5.2	4.1	5.3	Okinawa	2.2	2.1	3.4
Mie	3.2	2.4	4.0	mean (SD)	3.9 (1.6)		

Table 2 Prevalence rate of asthma among first grade elementary school students from 2017 to 2019

Prefecture	**Asthma (%)**			**Prefecture**	**Asthma (%)**		
	2017	2018	2019		2017	2018	2019
Hokkaido	5.8	3.9	4.0	Shiga	3.3	2.2	2.0
Aomori	1.5	1.2	1.8	Kyoto	4.0	3.5	2.6
Iwate	5.3	3.0	3.8	Osaka	2.6	2.5	2.4
Miyagi	6.2	5.4	5.1	Hyogo	4.1	3.5	3.2
Akita	4.5	3.2	3.3	Nara	1.1	1.0	2.0
Yamagata	5.9	4.6	4.6	Wakayama	1.6	2.6	1.8
Fukushima	3.6	3.9	1.4	Tottori	6.1	5.4	5.3
Ibaraki	6.5	5.3	6.2	Shimane	4.5	3.5	6.1
Tochigi	6.3	4.6	4.7	Okayama	3.7	3.6	5.3
Gunma	3.5	4.3	4.5	Hiroshima	2.5	2.6	2.4
Saitama	3.7	2.3	3.3	Yamaguchi	3.1	4.6	2.1
Chiba	5.3	6.6	5.6	Tokushima	3.0	3.4	2.6
Tokyo	4.3	4.3	3.7	Kagawa	4.0	3.9	2.7
Kanagawa	5.8	4.7	5.3	Ehime	2.7	2.8	3.0
Niigata	7.8	6.2	6.7	Kochi	2.8	4.2	1.4
Toyama	3.9	4.8	4.1	Fukuoka	4.2	2.0	1.9
Ishikawa	1.9	1.9	2.6	Saga	2.7	4.2	2.9

Fukui	2.2	2.9	2.2	Nagasaki	3.4	3.2	4.0
Yamanashi	3.6	3.9	2.5	Kumamoto	3.1	1.2	1.2
Nagano	5.2	5.8	4.9	Oita	2.7	2.5	3.4
Gifu	1.7	2.6	2.0	Miyazaki	3.5	3.0	3.4
Shizuoka	3.1	3.1	2.3	Kagoshima	2.7	2.1	3.1
Aichi	3.5	4.3	4.3	Okinawa	2.5	2.2	1.7
Mie	3.3	3.1	2.7	mean (SD)	3.5 (1.4)		

Table3 Prevalence rate of atopic dermatitis among first grade elementary school students from 2008 to 2010

Prefecture	**Atopic dermatitis (%)**			**Prefecture**	**Atopic dermatitis (%)**		
	2008	2009	2010		2008	2009	2010
Hokkaido	2.4	3.7	1.8	Shiga	4.3	2.7	3.3
Aomori	1.5	1.5	1.6	Kyoto	4.6	4.6	4.9
Iwate	3.7	2.8	2.2	Osaka	2.8	2.9	2.6
Miyagi	4.9	5.6	4.8	Hyogo	3.9	3.4	3.0
Akita	5.3	4.1	3.7	Nara	2.1	2.2	3.3
Yamagata	4.1	4.0	2.8	Wakayama	3.3	2.2	2.2
Fukushima	2.9	3.6	2.9	Tottori	8.1	7.1	7.6
Ibaraki	3.9	3.7	5.5	Shimane	5.9	6.3	5.6
Tochigi	3.3	2.1	2.7	Okayama	2.9	2.5	4.0
Gunma	3.2	3.0	2.3	Hiroshima	2.6	3.5	3.4
Saitama	3.2	2.6	3.5	Yamaguchi	3.1	2.1	2.8
Chiba	2.8	2.6	2.9	Tokushima	3.8	3.9	5.0
Tokyo	6.0	4.2	4.8	Kagawa	4.1	2.9	4.3
Kanagawa	2.4	2.0	3.1	Ehime	2.0	1.8	1.7
Niigata	6.2	5.5	4.4	Kochi	2.9	2.8	2.5
Toyama	4.5	4.0	4.0	Fukuoka	3.4	1.8	3.5
Ishikawa	3.0	4.1	3.6	Saga	2.8	2.4	2.9
Fukui	7.4	8.5	7.3	Nagasaki	3.4	3.0	5.1
Yamanashi	4.4	2.5	2.9	Kumamoto	1.9	1.3	2.4
Nagano	4.4	4.5	5.5	Oita	1.8	2.3	1.9
Gifu	4.0	3.3	4.5	Miyazaki	3.1	1.8	2.2
Shizuoka	4.1	3.8	3.1	Kagoshima	1.9	0.9	1.9
Aichi	6.2	4.0	5.0	Okinawa	2.1	2.3	2.8
Mie	4.0	2.8	3.3	mean (SD)	3.5 (1.4)		

Table 4 Prevalence rate of atopic dermatitis among first grade elementary school students from 2017 to 2019

Prefecture	Atopic dermatitis (%)			Prefecture	Atopic dermatitis (%)		
	2017	2018	2019		2017	2018	2019
Hokkaido	4.8	4.0	4.5	Shiga	3.2	2.8	3.0
Aomori	1.6	1.5	1.0	Kyoto	5.0	5.0	3.5
Iwate	2.5	3.9	3.7	Osaka	1.7	3.0	2.7
Miyagi	4.3	5.4	3.3	Hyogo	3.4	3.0	2.5
Akita	5.2	3.9	3.8	Nara	3.4	1.9	3.9
Yamagata	4.2	3.4	3.0	Wakayama	2.9	2.9	2.8
Fukushima	2.4	2.9	1.3	Tottori	5.9	6.0	5.7
Ibaraki	6.9	5.4	4.6	Shimane	4.6	5.5	6.3
Tochigi	3.1	4.3	4.0	Okayama	2.9	4.1	4.1
Gunma	2.0	2.7	3.6	Hiroshima	3.0	2.7	2.5
Saitama	3.3	2.8	2.3	Yamaguchi	2.2	3.8	1.4
Chiba	3.0	3.6	3.8	Tokushima	2.2	3.0	3.4
Tokyo	3.9	3.7	3.9	Kagawa	2.4	2.7	3.1
Kanagawa	2.5	3.1	2.8	Ehime	2.7	2.0	2.7
Niigata	4.9	4.7	6.3	Kochi	2.7	2.7	2.4
Toyama	2.6	2.7	2.9	Fukuoka	2.8	1.7	1.5
Ishikawa	2.2	2.8	2.3	Saga	2.7	2.6	3.1
Fukui	5.7	4.3	4.0	Nagasaki	3.6	3.3	4.5
Yamanashi	3.6	2.5	2.4	Kumamoto	1.7	2.1	2.2
Nagano	3.0	5.1	3.9	Oita	1.5	1.1	1.7
Gifu	3.4	3.5	3.8	Miyazaki	1.6	1.5	1.6
Shizuoka	2.5	4.3	2.3	Kagoshima	1.9	1.7	2.2
Aichi	4.9	6.7	6.3	Okinawa	1.6	2.6	1.7
Mie	2.6	2.9	2.7	mean (SD)	3.3 (1.3)		

3.2. Air pollutants and climatic conditions in the preschool environment

Table 5 and 6 show average values of photochemical oxidants in the preschool environment. Table 7and 8 show smoking rate, ambient temperature and relative humidity.

Table 5 Average concentration of photochemical oxidants in the preschool environment for first grade elementary school students from 2007 to 2019

Prefecture	Average concentration of photochemical oxidants (ppm)			Prefecture	Average concentration of photochemical oxidants (ppm)		
	2003-2007	2004-2008	2005-2009		2003-2007	2004-2008	2005-2009
Hokkaido	0.028	0.029	0.029	Shiga	0.034	0.035	0.035
Aomori	0.035	0.035	0.034	Kyoto	0.031	0.032	0.033
Iwate	0.028	0.029	0.029	Osaka	0.031	0.031	0.031
Miyagi	0.030	0.030	0.031	Hyogo	0.031	0.032	0.032
Akita	0.037	0.037	0.037	Nara	0.031	0.031	0.031
Yamagata	0.034	0.034	0.033	Wakayama	0.032	0.033	0.033
Fukushima	0.031	0.031	0.032	Tottori	0.033	0.033	0.034
Ibaraki	0.032	0.032	0.032	Shimane	0.038	0.038	0.038
Tochigi	0.029	0.030	0.031	Okayama	0.029	0.030	0.031
Gunma	0.032	0.032	0.033	Hiroshima	0.033	0.033	0.034
Saitama	0.029	0.030	0.030	Yamaguchi	0.031	0.032	0.033
Chiba	0.031	0.031	0.030	Tokushima	0.036	0.036	0.036
Tokyo	0.028	0.028	0.029	Kagawa	0.029	0.029	0.030
Kanagawa	0.026	0.027	0.027	Ehime	0.029	0.029	0.030
Niigata	0.033	0.034	0.035	Kochi	0.029	0.030	0.030
Toyama	0.036	0.036	0.036	Fukuoka	0.031	0.031	0.031
Ishikawa	0.035	0.036	0.036	Saga	0.031	0.032	0.033
Fukui	0.031	0.031	0.032	Nagasaki	0.033	0.034	0.035
Yamanashi	0.032	0.032	0.032	Kumamoto	0.028	0.029	0.030
Nagano	0.031	0.032	0.032	Oita	0.028	0.028	0.029
Gifu	0.029	0.031	0.032	Miyazaki	0.032	0.032	0.032
Shizuoka	0.030	0.031	0.032	Kagoshima	0.034	0.034	0.034
Aichi	0.028	0.029	0.030	Okinawa	0.026	0.026	0.027
Mie	0.031	0.032	0.032	mean (SD)	0.032 (0,003)		

Table 6 Average concentration of photochemical oxidants in the pre-school environment for first grade elementary school students from 2017 to 2019

Prefecture	Average concentration of photochemical oxidants (ppm)			Prefecture	Average concentration of photochemical oxidants (ppm)		
	2012-2016	2013-2017	2014-2018		2012-2016	2013-2017	2014-2018
Hokkaido	0.031	0.031	0.031	Shiga	0.036	0.036	0.036
Aomori	0.033	0.033	0.034	Kyoto	0.034	0.034	0.034
Iwate	0.031	0.031	0.032	Osaka	0.032	0.032	0.033
Miyagi	0.032	0.032	0.033	Hyogo	0.032	0.032	0.033
Akita	0.036	0.036	0.036	Nara	0.032	0.032	0.033
Yamagata	0.035	0.035	0.035	Wakayama	0.036	0.036	0.036
Fukushima	0.033	0.033	0.034	Tottori	0.036	0.036	0.036

Ibaraki	0.033	0.033	0.033	Shimane	0.039	0.039	0.040
Tochigi	0.032	0.032	0.033	Okayama	0.032	0.032	0.032
Gunma	0.037	0.037	0.037	Hiroshima	0.033	0.033	0.033
Saitama	0.033	0.033	0.033	Yamaguchi	0.035	0.035	0.035
Chiba	0.032	0.032	0.033	Tokushima	0.035	0.035	0.036
Tokyo	0.031	0.031	0.031	Kagawa	0.033	0.033	0.034
Kanagawa	0.031	0.031	0.031	Ehime	0.032	0.032	0.033
Niigata	0.037	0.037	0.037	Kochi	0.034	0.034	0.034
Toyama	0.037	0.037	0.037	Fukuoka	0.033	0.033	0.034
Ishikawa	0.038	0.038	0.038	Saga	0.036	0.036	0.037
Fukui	0.037	0.037	0.037	Nagasaki	0.036	0.036	0.036
Yamanashi	0.033	0.033	0.033	Kumamoto	0.034	0.034	0.034
Nagano	0.034	0.034	0.035	Oita	0.032	0.032	0.033
Gifu	0.034	0.034	0.034	Miyazaki	0.029	0.029	0.029
Shizuoka	0.034	0.034	0.034	Kagoshima	0.031	0.031	0.031
Aichi	0.032	0.032	0.032	Okinawa	0.030	0.031	0.030
Mie	0.035	0.035	0.035	mean (SD)	0.034 (0.002)		

Table 7 Smoking rate and climatic conditions in the pre-school environment for first grade elementary school students from 2008 to 2010

Prefecture	**#Smoking rate (%)**	**##Ambient temperature (□)**	**###Relative humidity (%)**	**Prefecture**	**#Smoking rate (%)**	**##Ambient temperature (□)**	**###Relative humidity (%)**
Hokkaido	30.5	9.3	68	Shiga	23.8	15.1	74
Aomori	28.5	10.7	75	Kyoto	23.3	16.2	63
Iwate	25.0	10.5	72	Osaka	25.9	17.4	63
Miyagi	26.8	12.7	72	Hyogo	22.9	17.2	65
Akita	25.3	12.1	73	Nara	21.4	15.2	71
Yamagata	24.3	12.0	75	Wakayama	23.3	17.1	62
Fukushima	26.5	13.3	69	Tottori	22.2	15.3	72
Ibaraki	25.7	14.0	73	Shimane	20.9	15.4	73
Tochigi	26.5	14.4	69	Okayama	23.4	16.7	66
Gunma	26.4	15.0	61	Hiroshima	23.2	16.6	68
Saitama	26.7	15.6	63	Yamaguchi	22.2	16.0	69
Chiba	26.3	16.3	68	Tokushima	22.5	17.1	65
Tokyo	24.8	16.7	59	Kagawa	23.6	16.9	65
Kanagawa	26.0	16.3	64	Ehime	22.0	17.0	66
Niigata	24.7	14.2	69	Kochi	23.6	17.6	68

Toyama	23.5	14.6	78	Fukuoka	25.9	17.6	65
Ishikawa	24.6	15.1	70	Saga	24.8	17.1	68
Fukui	23.2	14.9	74	Nagasaki	23.2	17.7	67
Yamanashi	25.4	15.3	62	Kumamoto	23.3	17.7	67
Nagano	23.3	12.2	71	Oita	23.3	17.1	66
Gifu	23.6	16.3	65	Miyazaki	23.5	17.9	71
Shizuoka	24.6	17.0	69	Kagoshima	21.3	19.1	66
Aichi	26.1	16.3	65	Okinawa	23.0	23.4	72
Mie	23.4	16.4	68	mean (SD)	24.3 (1.9)	15.6 (2.4)	68 (4)

[#] Average smoking rate of 2004 and 2007 surveys, [##] Average temperature from 2004 to 2007, [###] Average humidity from 2004 to 2007.

Table 8 Average concentration of photochemical oxidantss in the pre-school environment for first grade elementary school students from 2017 to 2019

Prefecture	**[#]Smoking rate (%)**	**[##]Ambient temperature (℃)**	**[###]Relative humidity (%)**	**Prefecture**	**[#]Smoking rate (%)**	**[##]Ambient temperature (℃)**	**[###]Relative humidity (%)**
Hokkaido	20.7	9.5	75	Shiga	18.5	15.3	73
Aomori	26.1	10.9	75	Kyoto	19.3	16.5	66
Iwate	24.9	11.0	70	Osaka	18.0	17.2	64
Miyagi	23.0	13.2	73	Hyogo	21.1	17.2	64
Akita	22.6	12.3	72	Nara	19.1	15.4	75
Yamagata	21.9	12.3	69	Wakayama	17.0	17.2	67
Fukushima	20.1	13.8	73	Tottori	19.3	15.5	74
Ibaraki	23.8	14.5	67	Shimane	18.9	15.4	77
Tochigi	22.5	14.6	61	Okayama	18.8	16.3	68
Gunma	22.3	15.3	63	Hiroshima	19.2	16.7	66
Saitama	22.6	15.7	65	Yamaguchi	19.3	15.9	75
Chiba	21.9	16.6	65	Tokushima	19.4	17.0	69
Tokyo	21.4	16.6	69	Kagawa	17.7	16.9	67
Kanagawa	19.6	16.6	73	Ehime	18.4	16.9	69
Niigata	19.9	14.1	73	Kochi	18.1	17.5	70
Toyama	20.9	14.7	70	Fukuoka	20.6	17.6	70
Ishikawa	19.6	15.2	74	Saga	22.0	17.2	72
Fukui	20.5	15.1	62	Nagasaki	22.4	17.5	73
Yamanashi	20.1	15.4	73	Kumamoto	20.6	17.3	73
Nagano	21.9	12.5	65	Oita	20.9	16.9	71
Gifu	19.8	16.5	68	Miyazaki	20.4	17.9	76
Shizuoka	19.1	17.2	65	Kagoshima	20.7	19.0	73
Aichi	20.8	16.5	67	Okinawa	18.6	23.5	73
Mie	20.0	16.5	68	mean (SD)	20.5 (1.9)	15.8 (2.3)	70 (4)

[#] Average smoking rate of 2013 and 2016 surveys, [##] Average temperature from 2013 to 2016, [###] Average humidity from 2013 to 2016.

3.3. Stepwise multiple linear regression analysis

As shown in Table 9, stepwise multiple regression analysis with asthma rate as the objective variable, atopic dermatitis rate, smoking rate, photochemical oxidants, ambient temperature and relative humidity as explanatory variables, revealed that atopic dermatitis rate and smoking rate are significant independent variables.

Table 9 Stepwise multiple regression analysis with asthma rate as the objective variable, atopic dermatitis rate, smoking rate, photochemical oxidants, ambient temperature and relative humidity as explanatory variables

	Independent variables	**Estimated regression coefficient B**	**95% confidence interval**		**Partial regression coefficient β**	**Cumulative R^2**	***P*-value**
			Lower bound	Upper bound			
First investigation	Intercept	-3.780	-6.571	-0.990	-	-	0.008
	Atopic dermatitis rate	0.757	0.614	0.900	0.667	0.398	0.000
	Smoking rate	0.204	0.095	0.314	0.236	0.452	0.000
Second investigation	Intercept	-1.818	-3.885	0.249	-	-	0.084
	Atopic dermatitis rate	0.643	0.496	0.790	0.574	0.351	0.000
	Smoking rate	0.160	0.060	0.260	0.211	0.395	0.002

As shown in Table 10, in the first investigation of stepwise multiple regression analysis with atopic dermatitis rate among first grade elementary school students as the objective variable, smoking rate, photochemical oxidants, ambient temperature and relative humidity as explanatory variables, photochemical oxidants were significant independent variable. Ambient temperature and photochemical oxidants were significant independent variables in the second investigation.

Table 10 Stepwise multiple regression analysis with atopic dermatitis rate as the objective variable, smoking rate, photochemical oxidants, ambient temperature and relative humidity as explanatory variables

	Independent variables	**Estimated regression coefficient B**	**95% confidence interval**		**Partial regression coefficient β**	**Cumulative R^2**	***P*-value**
			Lower bound	**Upper bound**			
First investigation	Intercept	-1.019	0.013	0.054	-	-	0.478
	Photochemical oxidants	143.527	54.433	232.621	0.261	0.068	0.002
Second investigation	Intercept	1.549	-2.005	5.103	-	-	0.390
	Ambient Temperature	-0.146	-0.233	-0.059	-0.267	0.092	0.001
	Photochemical oxidants	118.685	28.625	208.744	0.210	0.135	0.010

Figure 1 shows the relationship between photochemical oxidants and atopic dermatitis based on the results of the first investigation.

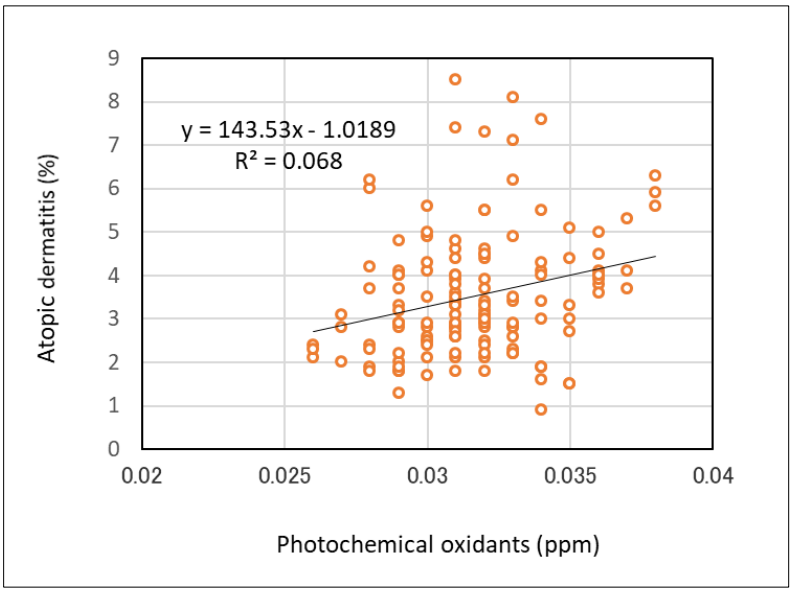

Figure 1 Relationship between photochemical oxidants and atopic dermatitis based on the results of the first investigation

4. Discussion

Air pollutants and climatic conditions are potential factors in the development of childhood asthma and atopic dermatitis [8, 9]. Asthma is usually classified as atopic and non-atopic [10]. Atopy is associated with allergens that cause allergic reactions [11]. The results shown in Table 5 suggest that the tobacco smoke is a risk factor for non-atopic asthma rather than atopic asthma [12-17]. Tobacco smoke is an irritant that irritates the airways and can exacerbate asthma and cause those asthma symptoms [18-20]. Photochemical oxidants and ambient temperature were significant independent variables for atopic dermatitis. The relationship between the photochemical oxidant concentration in Figure 1 and the incidence of atopic dermatitis may suggest a dose-response relationship. However, there is a limitation that the results of regression analysis cannot prove a causal relationship.

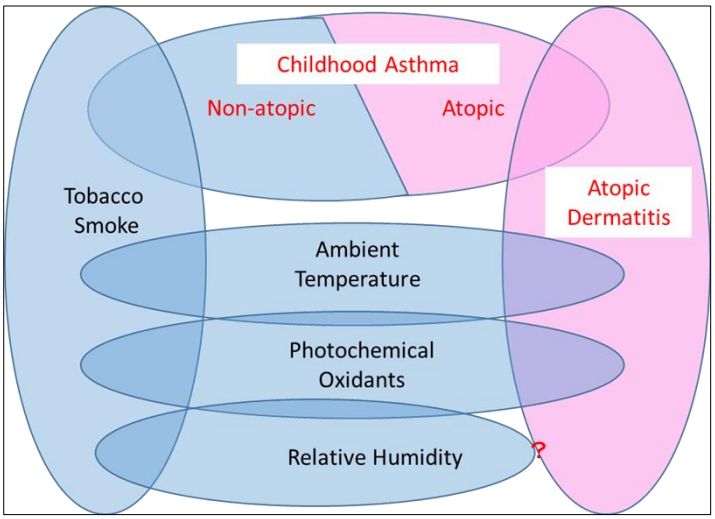

Figure 2 Relationship between childhood asthma, atopic dermatitis and environmental factors

Photochemical oxidants are strong oxidative stressors that produce reactive oxygen species (ROS), such as superoxide (O_2-) and hydrogen peroxide (H_2O_2). ROS causes skin barrier dysfunction and inflammation that develops atopic dermatitis [21-24]. Cold temperatures can cause allergic reactions such as cold urticarial, leading to a reproducible and significant increase in histamine-induced itching [25-27]. Itching is a major symptom of many allergic or inflammatory

skin disorders. In addition, low humidity and low temperatures lead to a general reduction in skin barrier function, making them more susceptible to mechanical stress [28].

When the results obtained in this study and the research results reported by the author [29, 30] are combined, the relationship between childhood asthma and atopic dermatitis and environmental factors such as tobacco smoke, temperature, and humidity is as follows (Figure 2).

5. Conclusion

Present study suggests that preschool indoor and outdoor conditions such as environmental tobacco smoke, photochemical oxidants, and ambient temperature may be associated with the development of childhood asthma and atopic dermatitis.

Compliance with ethical standards

Acknowledgments

The author appreciates the help of colleagues in the laboratory.

Disclosure of conflict of interest

There is no conflict of interest in this work.

References

[1] Elina Toskala, David W Kennedy, Asthma risk factors. International Forum of Allergy & Rhinology, Vol. 5, No. S1, September 2015 S16

[2] D Solé, IC Camelo-Nunes,1 GF Wandalsen, AC Pastorino, CMA Jacob, C Gonzalez, NF Wandalsen, NA Rosário Filho, GB Fischer, CK Naspitz. Prevalence of Symptoms of Asthma, Rhinitis, and Atopic Eczema in Brazilian Adolescents Related to Exposure to Gaseous Air Pollutants and Socioeconomic Status. J Investig Allergol Clin Immunol. 2007; 17(1): 6-13.

[3] Ki Lee Milligan, Elizabeth Matsui, Hemant Sharma, Asthma in Urban Children: Epidemiology, Environmental Risk Factors, and the Public Health Domain. Curr Allergy Asthma Rep. 2016; Apr; 16(4): 33.

[4] A Vanker, R P Gie, H J Zar. The association between environmental tobacco smoke exposure and childhood respiratory disease: a review. Expert Rev Respir Med. 2017; 11(8): 661-673.

[5] Eleni Drakaki, Clio Dessinioti, Christina V. Antoniou, Air pollution and the skin. Front Environ. Sci. 15 May 2014; 00011.

[6] Dotterud LK, Kvammen B, Bolle R, Falk ES, A survey of atopic diseases among school children in Sør-Varanger community. Possible effects of subarctic climate and industrial pollution from Russia. Acta Derm Venereol (Stockh). 1994; 74: 124-128.

[7] JSC English, RS Dawe, J Ferguson. Environmental effects and skin disease. Br Med Bull. 68: 129–142.

[8] Yabin Hu, Zhiwei Xu, Fan Jiang, Shenghui Li, Shijian Liu, Meiqin Wu, Chonghuai Yan, Jianguo Tan, Guangjun Yu, Yi Hu, Yong Yin, Shilu Tong. Relative impact of meteorological factors and air pollutants on childhood allergic diseases in Shanghai, China. Sci Total Environ. 1 Mar 2020; 706: 135975.

[9] Juanjuan Zhang, Jihong Dai Li Yan, Wenlong Fu, Jing Yi, Yuzhi Chen, Chuanhe Liu, Dongqun Xu, Qiang Wang. Air Pollutants, Climate, and the Prevalence of Pediatric Asthma in Urban Areas of China. BioMed Research International. 2016; 2935163: 8.

[10] CS Court, DG Cook, DP Strachan. Comparative epidemiology of atopic and non-atopic wheeze and diagnosed asthma in a national sample of English adults. Thorax. 2002; 57(11): 951-957.

[11] Simon F Thomsen. Epidemiology and natural history of atopic diseases. Eur Clin Respir J. 2015; 2: 10.3402/ecrj.v2.24642.

[12] E Rönmark, E Jönsson, T Platts-Mills, B Lundbäck. Different pattern of risk factors for atopic and nonatopic asthma among children--report from the Obstructive Lung Disease in Northern Sweden Study, Allergy. 1999; 54(9): 926-935.

[13] Juha Pekkanen, Jussi Lampi, Jon Genuneit, Anna-Liisa Hartikainen, Marjo-Riitta Järvelin. Analyzing atopic and non-atopic asthma. Eur J Epidemiol. 2012; 27(4): 281-286.

[14] Donna C Rennie, Chandima P Karunanayake, Josh A Lawson, Shelley Kirychuk, Kathleen McMullin, Sylvia Abonyi, Jeremy Seeseequasis, Judith MacDonald, James A Dosman, Punam Pahwa, Domestic Risk Factors for Atopic and non-atopic asthma in first nations children living in Saskatchewan, Canada. Children (Basel). 2020; 7(5): 38.

[15] Ana Lucia Moncayo, Maritza Vaca, Gisela Oviedo, Silvia Erazo, Isabel Quinzo, Rosemeire L Fiaccone, Martha E Chico, Mauricio L Barreto, Philip J Cooper, Risk factors for atopic and non-atopic asthma in a rural area of Ecuador. Thorax. 2010; 65(5): 409-416.

[16] Hussain Booalayan, Mosa Abdualrasool, Saad Al-Shanfari, Abdulwahab Boujarwa, Abdullah Al-Mukaimi, Omar Alkandery, Saeed Akhtar. Exposure to environmental tobacco smoke and prevalence of asthma among adolescents in a middle eastern country. BMC Public Health. 2010; 20: 1210.

[17] DP Strachan, DG Cook. Health effects of passive smoking. 6. Parental smoking and childhood asthma: longitudinal and case-control studies. Thorax. 1998; 53(3): 204-212.

[18] Emil Bogen. Irritant Factors in Tobacco Smoke. California and Western Medicine. 1936; 45(4): 342-346.

[19] RJ Shephard. Respiratory irritation from environmental tobacco smoke. Arch Environ Health. 1992; 47(2): 123-130.

[20] Gilmour MI, Jaakkola MS, London SJ, Nel AE, Rogers CA. How exposure to environmental tobacco smoke, outdoor air pollutants, and increased pollen burdens influences the incidence of asthma. Environ Health Perspect. 2006; 114(4): 627-633.

[21] Sukriti Sharma, Amarjit S Naura. Potential of phytochemicals as immune-regulatory compounds in atopic diseases: A review. Biochem Pharmacol. 2020; 173: 113790.

[22] Hongxiu Ji, Xiao-Kang Li. Oxidative Stress in Atopic Dermatitis. Oxidative Medicine and Cellular Longevity. 2016, 2721469: 8.

[23] Lucrezia Bertino, Fabrizio Guarneri, Serafinella Patrizia Cannavò, Marco Casciaro, Giovanni Pioggia and Sebastiano Gangemi, Oxidative Stress and Atopic Dermatitis. Antioxidants. 2020; 9(3): 196.

[24] Yoshimichi Okayama, Oxidative stress in allergic and inflammatory skin diseases. Curr Drug Targets Inflamm Allergy. 2005; 4(4): 517-519.

[25] Florian Pfab, Michael Valet, Till Sprenger, Thomas R Toelle, Georgios I Athanasiadis, Heidrun Behrendt, Johannes Ring, Ulf Darsow, Short-term alternating temperature enhances histamine-induced itch: a biphasic stimulus model. J Invest Dermatol. 2006; 126(12): 2673-2678.

[26] F Pfab, M Valet, T Sprenger, J Huss-Marp, G I Athanasiadis, HJ Baurecht, A Konstantinow, C Zimmer, H Behrendt, J Ring, T R Tölle, U Darsow, Temperature modulated histamine-itch in lesional and nonlesional skin in atopic eczema - a combined psychophysical and neuroimaging study. Allergy. 2010; 65(1): 84-94.

[27] JSC English, RS Dawe, J Ferguson. Environmental effects and skin disease. Br Med Bull. 68: 129–142.

[28] KA Engebretsen, JD Johansen, S Kezic, A Linneberg, JP Thyssen. The effect of environmental humidity and temperature on skin barrier function and dermatitis. J Eur Acad Dermatol Venereol. 2016; 30(2): 223-249.

[29] S Suna, Pollutants and climatic conditions related to the smoking rate. World Journal of Biology Pharmacy and Health Sciences. 2021; 8(2): 34–41.

[30] S Suna. Pollutants and climatic conditions related to the formation of photochemical oxidants. World Journal of Biology Pharmacy and Health Sciences. 2021; 5(2): 1–5.