ASSESSING THE RELATIONSHIP AMONG HOUSEHOLD ENVIRONMENT, DRINKING WATER AND PREVAILING ASTHMA IN KARACHI

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تلخیص

اس ریسرچ میں دمہ اور گھروں کے اندرونی ماحول میں موجود عوامل میں تعلق کا احاطہ کیا گیا ہے۔ دمے کے شماریات کے لئے IUALDT کا ترمیمی سوالنامہ استعمال کیا گیا ہے۔Uni Variate Analysis کی مدد سے کوالیٹیو (صفاتی) عوامل کا تجزیہ کیا گیا ہے تاکہ دمے اور اندرونی گھریلو عوامل میں تعلق واضح ہو جائے۔ نتیجہ یہ بتاتے ہیں کہ 8% فیصد لوگوں میں دمہ موجود ہے۔ مزید یہ ہے کہ تعلق کی وضاحت کے لیے Chai-Square, Wald Logistic, Omnibus Test اور Hosmer and Lamshow Test کا استعمال کیا گیا ہے۔ جو لوگ ابلا ہوا پانی استعمال کرتے ہیں وہ نسبتاً محفوظ ہیں۔ گھریلو اور اندرونی عوامل میں سگریٹ نوشی، قالین، نمی اور ہوا کا گزر اہم ترین عوامل ہیں۔

Abstract

This paper explored the relationship between asthma and household (indoor) environmental triggers. A modified version of International union against tuberculosis and lung disease (IUATLD) questionnaire has been used for asthma indices. Univariate analysis was performed to displaying frequencies and percentages for qualitative variables. Nearly 8.3 % (n=79) of the total population sample was found to suffer from asthma due to one or more reason. For checking the association of indoor affected variables with presence of asthma in subjects, chi-square test was used. If the P value came out to be at-most 0.05, the association was considered to be significant. Variables, which showed significant association in chi-square test, were kept in advanced analysis. Effect model was build using Forward Wald Logistic Regression method with probability of stay = 0.05. Omnibus test was performed for the significance of model. Hosmer and Lameshow test was run to check any heterogeneity among variation in the model. People who use boiling water are little safe from asthma. Other indoor triggers *i.e.* smoking, use of carpet, household dampness, and ventilation are having significant role for asthma occurrence.

Introduction

Asthma is one of the respiratory diseases, which is emerging by environmental deterioration including indoor surroundings. Now Asthma is a serious global health issue. People of all ages throughout the world are affected by this chronic disorder of the airways that can be severe and sometimes fatal (WHO, 2002). Indoor household environment always plays an important role in human health. Most common health problem are associated with poor indoor air quality in homes (Sharpe *et al.,* 2015). Deprived indoor air quality can contribute to the progress of chronic respiratory diseases like asthma. In poor indoor air quality, people who already have respiratory diseases are at greater risk. There are several types of pollutants normally found in a house. Some of the most common indoor asthma triggers include smoke, dust mites, mold or fungus, cockroaches and other pests, household pets, curtain, strong odor or perfume and kitchen fumes (Shani *et al.,* 2015).

Indoor triggers play significant role in asthma attacks. Mainly two types of indoor pollutants – biological and non-biological pollutants, are found in literature. Biological pollutants include molds, bacteria, viruses, pollen, dust mites, and animal dander that promote poor indoor air quality and may be a major cause of asthma (Bjornsson *et al.,* 1995; Sarpong *et al.,* 1996; Mishra, 2003; Findley *et al.,* 2003). In office buildings, heating, cooling, and airing (ventilation) systems are regular sources of biological substances that are inhaled, foremost to breathing problems (Delfino, 2002). Non-biological pollutants are different gases like methane, carbon monoxides, etc and tobacco and other smoke could be possible. Ventilation of the house is the key in the case of domestic pollution to reduce and not to reduce domestic pollution (Siddiqui *et al.,* 2005; WHO, 2010; WHO, 2012). Drinking water can also have significant effect on allergic respiratory issues (Hageskal *et al.,* 2006; Seo *et al.,* 2008a & 2008b).

It is evident that the prevalence of asthma is increasing all over the world. Asthma is a serious chronic lung disease affecting over six million Pakistani, including 10-15% of children. About 8% Karachiities have chronic asthma. It is increasing at an alarming rate, leading some to call it an epidemic. This disease has great impact on public health and the economy (Pakistan chest society, 2006). This biggest city of Pakistan is facing serious environmental deterioration. Lack of environmental legislation; ineffective implementation; improper

communication in inter-departmental works; unsustainable development; uncontrolled urbanization and chaotic land use have been the reasons behind this perpetual degradation. Development like industrial units expansion, building projects, construction of roads, housing colonies, and utility lines construction; improper environment quality management, waste management and disposal system; lack of health education of the people, poverty and un-affordability are some of the other causes that make the man's living conditions unhygienic and unhealthy (Ilyas *et al.,* 1993; Khan, 2011). According to Pakistan chest society every 250th death in Karachi is asthma oriented (Pak. chest society, 2006).

Approximately 24 million people live in Karachi and almost half of this living in slum areas which serve as an ideal condition for different diseases especially respiratory diseases like asthma and other allergic diseases are on the rise. The main objective of this study is to explore the role of indoor asthma triggers in the spread of asthma, as it is one of the diseases emerging as a result of environmental degradation in Karachi.

Material and methods

a) Study Area

The area of the present study constitutes two towns of the Karachi District i.e. ***Landhi Town*** and ***Korangi Town.*** Both towns are famous industrial towns situated in the eastern part of Karachi. These are bordered by the Faisal Cantonment, Shah Faisal Town, Bin Qasim Town and the Malir River. Landhi Town consists of twelve union councils while Korangi has been divided into nine.

b) Base Mapping

We used QuickBird 2007 satellite image to develop the digital map for the study area on 1: 5000 scale in GIS format by using ArcGIS 9.3. Base map data was modeled in GIS layers viz. Roads, Points of Interests (POIs) and Land use / Land cover (LULC). Published administrative boundary maps by City District Government Karachi (CDGK) were used to define Towns and UCs. This GIS map is used for survey planning and questionnaire execution (Fig.1).

c) Questionnaire Development and Execution

A questionnaire has been developed to evaluate asthma indices and its related information with keeping in mind a number of other asthma questionnaires to fulfill basic asthma criteria for disease confirmation and associated information (Burney *et al.,* 1989). Several environmental aspects were considered to explore the factors relating to objectives of study i.e. person*al.*, gender, age, education, occupation, economic status, family size, house size, and indoor environmental triggers i.e. dampness, insects, pets and plants etc (GINA, 2002; Nafstad *et al.,* 2001; Leaderer *et al.,* 2002, Chrischilles *et al.,* 2004).

The stratified random sampling method was used with Union Councils as strata for getting data almost 0.1%. This sample size was determined by keeping the available human and financial resources in view and the proper coverage of the Landhi and Korangi towns of Karachi City District. To avoid the confusion of respondent in the development of questionnaire maximum questions were designed as close ended (multiple option based) (Table 1).

The executed sample frame was based on 987 questionnaires from randomly selected households and collected information about respiratory diseases in Landhi and Korangi along with their physic*al*, biological and socioeconomic environment. During survey execution, field observations were also noted with each questionnaire such as sewerage and drainage conditions in neighborhoods; encroachments and behavior of the people of the area, but in this paper we are mainly discussing about indoor asthma triggers (Table 1).

d) Statistical Analysis

The analytical process of this research was focused on association of asthma and indoor environmental factors. However, at first creation of themes of collected and linked data was undertaken and lastly all outcomes were qualitatively examined based on the knowledge of the study area. Data were entered in Microsoft Excel and analyzed with IBM Statistical Programming for Social Sciences (SPSS v. 20). Univariate analysis was done displaying frequencies and percentages for qualitative variables. For checking the association of indoor affected variables with presence of asthma in subjects, chi-square test was used. If the P value came out to be at-most 0.05, the association was considered to be significant. Variables, which showed significant association in chi-square test, were kept in advanced analysis. Effect model was build using Forward Wald Logistic Regression method with probability of stay = 0.05. Omnibus test was performed for the significance of model. Hosmer and Lameshow test was run to check any heterogeneity among variation in the model.

Results and Discussion

Out of 956 participants, 8.3% (n = 79) diagnosed to have asthma disease. About 85% of them (n = 67) used water from pipelines as provided by Karachi Water Board Supply (KWBS). Notably, only 20% (n = 16) used boiled

water for drinking. People who used boiled water were significantly more percentage to be safe from asthma (P = 0.019). Almost all the participants (n=952) used Natural Gas as an energy source for cooking and fuel etc. Very few asthma sufferers admitted to be allergic from smoking (n = 24). However, use of carpet is considered to be nearby significant affected variables to be allergen for asthma (P = 0.056). An increased in the proportions of having asthma is observed with the increase exposure of ventilations indoor (P = 0.005). Asthma observed less in wash wet and wet moisture (P = 0.001). Asthma allergy with plants, kitchen ventilation and with insects like cockroach and rats also had some significant impact in the patients (Table 2).

Effect model was build and displayed in table 3. Hosmer and Lameshow test showed that model is good fitted (Fig.2). A high proportion of the data (92%) was correctly classified. From the effect model, it is clearly observed that not using boiling water increases the doubles the risk of having asthma as compare to those who does not suffer asthma (OR = 1.9, P = 0.031). The ventilation changed the chances of asthma patients 3 folds higher than the non-asthma subjects. The moisturizer also amended the risk of asthma to 4 times less in wet conditions (Fig. 2).

Indoor atmosphere may add to the expression of respiratory symptoms in tending persons (Nafstad *et al.,* 2001). In this study we also inquire source of water, its quality and usage but some small significance found in this regard. While at large, several investigations suggested that the percentage of alleged respiratory symptoms attributed to specific environmental exposures, and relations related to indoor climate hazard indicators, *i.e.* occurrence of dampness or mold, inadequate ventilation conditions and reduction on windows or fresh air. Several studies have verified an increase in the prevalence of asthma by this lacking of ventilation (Brunekreef *et al.,* 1989).

In the study area besides planned housing schemes, there were some unplanned slum settlements, which were included in asthma survey as well. We observed many awful activities in this study *i.e.* burning garbage and small scale commercial activities such as recovery of metals from tires by burning them, and usage of wooden powder as fuel in local small hotels. All these activities had polluted the environments that lead to respiratory problems.

There is an association of health problems with indoor to external air pollution that includes several respiratory infection especially among children, chronic obstructive pulmonary disease (COPD), asthma, bronchitis, risk for tuberculosis and very low birth (Crain *et al.,* 2002; WHO, 2002; Mishra, 2003; Wallace *et al*., 2003; Boy *et al*., 2002 and Mishra *et al*., 1999).

Strength and Limitations

This paper is an effort to assess indoor asthma triggers as most of the asthma related studies are mainly focus on outdoor environmental factors. However, it has many limitations as well *i.e*. this paper mainly discuss only indoor asthma triggers but simultaneously not with outdoor triggers that could enhance its significance and strength, also no measurement for indoor asthma triggers *i.e.* kitchen fumes, humidity and ventilation etc. No medically linked examination of water and asthma relationship. All evaluation was made only with questionnaire data. This study also tells us the need for further evaluation of many parameters like water sources and its quality and temporal data assessment and clinical evaluation.

Conclusion

We assessed the exposure to multiple household indoor respiratory triggers associated with the asthma. In this study we done several analysis with factors like drinking water sources and several household indoor respiratory triggers such as moisture, pets, flora and fauna, kitchen fumes ventilation, stove fuel, usage of carpets and curtains with asthma data. Influence on asthma prevalence most of them statistically minorassociation, while some of them are very significant like moisture conditions and usage of carpets.

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Table1. Selected indoor environmental variables by questionnaire

1. Boiled Drinking Water Users
2. Direct Supplied or Extracted Drinking Water Users
3. Fuel Gas Users Supplied by SSGC
4. Houses with Bird Pets
5. Houses with Carpet Use
6. Houses with Flora
7. Houses with High Prevailing Moisture
8. Houses with Kitchen Ventilation inside the House
9. Houses with Kitchen Ventilation outside the House
10. Houses with Low Prevailing Moisture
11. Houses with Mammal Pets
12. Houses with Prevailing Insects and Rodents
13. Houses with Prevailing Moisture
14. Houses with / without Carpet Use
15. Houses without Flora
16. Houses without Prevailing Insects and Rodents
17. Houses without Prevailing Moisture
18. Moderately Ventilated Houses
19. Non-smokers
20. No-ventilated Houses
21. Smokers
22. Well Ventilated Houses

Table 2. Association of asthma allergen triggers among residents of Karachi, Pakistan

		Presence of Asthma				P Value
		No (877)		Yes (79)		
		n	%	n	%	
Single source of water	**Line**	768	87.6	67	84.8	0.654
	Boring	81	9.3	10	12.7	
	Tanker	7	0.8	0	0.0	
	Others	19	2.2	2	2.5	
Multiple sources of water	**None**	816	94.9	73	96.1	0.957
	Line & Boring	42	4.9	3	3.9	
	Boring & Tanker	1	0.1	0	0.0	
	Line & Tanker	1	0.1	0	0.0	
Boiled water	**No**	587	66.9	63	79.7	0.019
	Yes	291	33.1	16	20.3	
Smoking	**No**	645	73.5	55	69.6	0.450
	Yes	232	26.5	24	30.4	
Carpet	**No**	554	63.0	56	72.7	0.089
	Yes	325	37.0	21	27.3	
Ventilation	**No**	89	10.1	17	21.8	0.005
	Low	409	46.6	28	35.9	
	High	380	43.3	33	42.3	
Moisture	**Rarely**	478	55.6	59	77.6	0.001
	Wash Wet	123	14.3	8	10.5	
	Wet	259	30.1	9	11.8	
Plants	**No**	503	57.4	51	64.6	0.214
	Yes	374	42.6	28	35.4	
Kitchen ventilation	**In**	189	21.7	14	17.7	0.406
	Out	681	78.3	65	82.3	

Cockroach	**No**	262	30.2	23	29.5	0.525
	Few	345	39.8	37	47.4	
	Much	168	19.4	12	15.4	
	Very Much	92	10.6	6	7.7	
Rats	**No**	269	31.2	23	29.9	0.981
	Few	304	35.2	27	35.1	
	Much	174	20.2	17	22.1	
	Very Much	116	13.4	10	13.0	
Nearby Industry / Factory	**No**	761	89.0	46	59.0	0.000
	Yes	94	11.0	32	41.0	
Air pollution	**No**	674	82.0	26	34.2	0.000
	Yes	148	18.0	50	65.8	
Air conditioner	**No**	673	83.1	34	47.2	0.000
	Yes	137	16.9	38	52.8	
Pollens	**No**	805	99.3	68	97.1	0.073
	Yes	6	0.7	2	2.9	
During travel	**No**	764	95.9	62	88.6	0.006
	Yes	33	4.1	8	11.4	
Dust	**No**	687	83.8	32	42.7	0.000
	Yes	133	16.2	43	57.3	
Self-smoking	**No**	778	96.8	66	91.7	0.027
	Yes	26	3.2	6	8.3	
Others smoking	**No**	772	95.0	58	80.6	0.000
	Yes	41	5.0	14	19.4	
Kitchen smoke	**No**	773	95.1	60	85.7	0.001
	Yes	40	4.9	10	14.3	

Table 3. Effect model for asthma using indoor asthma triggers

Variables in the Effect Model	**Coefficient**	**Standard Error**	**Wald**	**Degrees of Freedom**	**P Value**	**Odds Ratio (OR)**	**95% C.I. for OR**	
							Lower	**Upper**
Boil Water	-1.169	0.379	9.516	1	0.002	0.311	0.148	0.653
Carpet	-0.640	0.323	3.936	1	0.047	0.527	0.280	0.992
Nearby Industry/ Factory	0.942	0.318	8.776	1	0.003	2.564	1.375	4.782
Air Pollution	1.113	0.374	8.831	1	0.003	3.043	1.461	6.339
Air conditioner	0.768	0.329	5.434	1	0.020	2.155	1.130	4.109
Dust	0.761	0.357	4.554	1	0.033	2.141	1.064	4.309
Constant	-3.109	0.234	176.185	1	<0.0001	0.045		

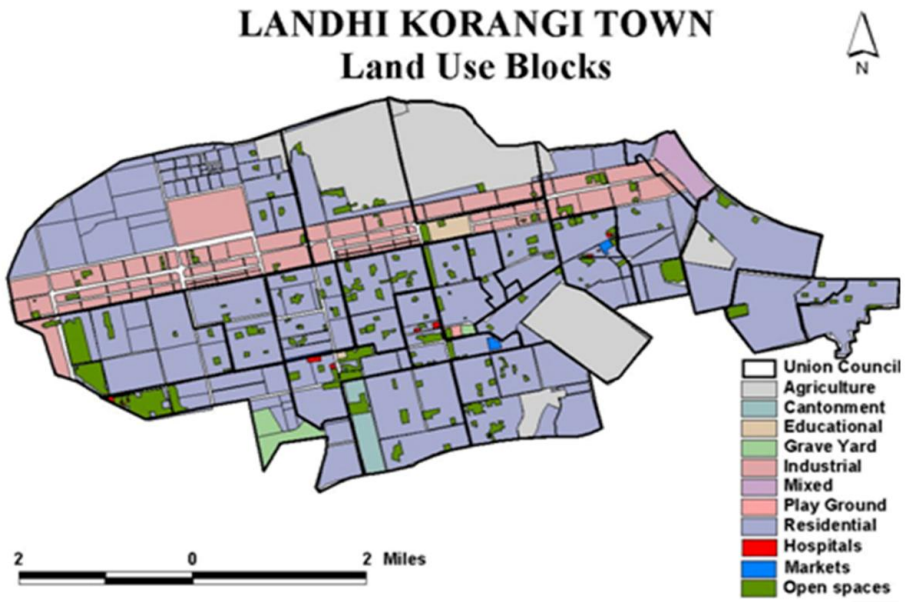

Figure 1: Landuse of Landhi and Korangi Towns

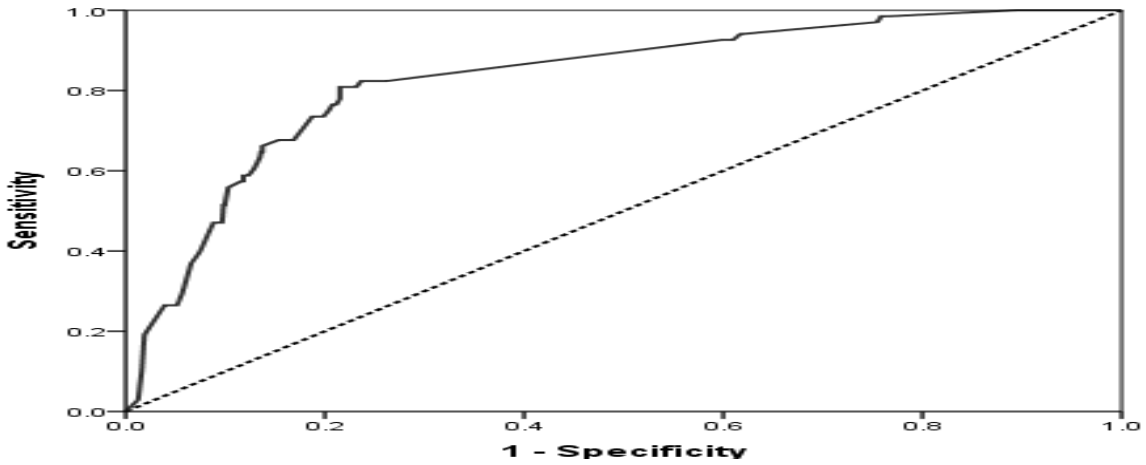

Figure 2. Receiver operating characteristic (ROC) curve covered, Area under ROC Curve (AUC) = 83.1%, portraying good validity of predictors made by effect model.

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