

A New Method For Feature Selection in Diagnosis Using DEMATEL and ANP; Case Study: Asthma

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Abstract

Disease is one of the effective factors in decreasing life quality of human beings and since many factors are effective in engendering this disease and each of these effective factors can cause prevalence and aggravation of disease, recognition of risk factors and also relationships among these factors are so important. Using the opinion of experts can make new method in intelligent systems of disease recognition. In the present research at first we mentioned the relationships among asthma disease factors by using experts' opinion in group decision making method, DEMATEL and then we extracted the most important factors by analysis network path (ANP) and since risk factors are different in multiple countries, for recognition of local factors in Iran country, database including 325 cases of asthmatic and non-asthmatic disease is prepared and the most important risk factors of asthma disease in Iran society are recognized. The results of research show that the most important variables of asthma disease in Iran country are genetic factors of individuals, wheeze and environmental pollution.

Keywords: DEMATEL, ANP, Feature Selection, Asthma

1. Introduction

Asthma is the most prevalent chronic disease in children and adolescents which causes much morbidity increase, mortality and health care expenditure. In addition to the mortality augmentation caused by this disease, asthma has a lot of effects on the life quality and children's educational activities. It is clear that false diagnosis and inappropriate therapy are two factors which help morbidity and mortality increase in asthmatic illness which both occur for the reason of lack of knowledge in the patients and the families. Documents show that there is a considerable difference between accepted asthma prevalence by physicians and the asthma related to symptoms in medical researches which it shows the lack of asthma recognition by physicians in Iran (Tootoonchi, 2004). By better identification of pathogenic mechanisms in asthma ailment and the efficient communication in effective variables in asthma and determining the most important of them, one can promote people and patients' knowledge and this trend causes the disease symptoms and the asthmatic patient's life quality to be connection intensity as scoring searches. Feedbacks with their significance and accepts the transferable relationships.

Hence the important risk factors of asthma selection is required to handle several complex factors in a better sensible and logical manner. Thus, the important risk factors of asthma selection is a kind of multiple criteria decision-making (MCDM) problem, and requires MCDM methods to solve it appropriately.

Many traditional MCDM methods are based on the additive concept along with the independence assumption, but each individual criterion is not always completely independent. (Leung, Hui, & Zheng, 2003; Shee, Tzeng, & Tang, 2003). For solving the interactions among elements, the analytic network process (ANP) as a relatively new MCDM method was proposed by Saaty (1996). The ANP is a mathematical theory that can deal with all kinds of dependence systematically (Saaty, 2004). The ANP has been successfully applied in many fields (Agarwal & Shankar, 2002;, Chung, Lee, & Pearn, 2005; Coulter & Sarkis, 2005; Kahraman, Ertay, & Buyukozkan, 2006; Karsak, Sozer, & Alptekin, 2003; Lee & Kim, 2001; Meade & Presley, 2002; Niemira & Saaty, 2004; Partovi, 2001; Partovi & Corredoira, 2002; Partovi, 2006; Shang, Tjader, & Ding, 2004; Tesfamariam & Lindberg, 2005; Yurdakul, 2004).

However, the treatments of inner dependences in those ANP works were not complete and perfect. Indeed, the Decision Making Trial and Evaluation Laboratory (DEMATEL) not only can convert the relations between cause and effect of criteria into a visual structural model (Gabus Shimizu, 1999), but also can be used as a wise way to handle the inner dependences within a set of criteria, As the ANP and the DEMATEL have these advantages.

This paper proposes an effective solution based on a combined ANP and DEMATEL approach to help doctors make a correct diagnosis and appropriate treatment of asthma. Also, uses DEMATEL to explore the relationship between various elements of the asthma development in Iran and uses ANP to explore the most important factors of asthma in Iran.

In this research, for the target of risk factor identification and the influence of each of them on one another, they are introduced by using the feedback rings. Henceforth by applying ANP technique, the important factors which are the basic causes of the other factors are identified and prioritized. Liang L-W and his colleagues at first applied six aspects of the financial tools and strategies in agricultural business and they also provided a questionnaire by the assistant of specialists and experts. They applied DEMATEL method for the aim of ascertaining strategies and important financial tools and also the direct link among effective factors.

The rest of this paper is organized as follows. In Section 2, Literature Review, In Section 3, the theoretical foundations of DEMATEL and ANP, in Section 4, is devoted to discussion. In Section 5, the conclusions are discussed and in section 6, finally Suggestions for Future Research are given.

2. Literature Review

According to the research, Cheng and Zhang (2007) used ANP to find out key selecting criteria for a strategic partner and further to identify the relative importance among the criteria. Lee et al. (2002) uses ANP to analyze the problem of network technology, to consider the related technology network technology require, and to seek out the core technology and the characteristics of network technology. Hsieh et al. (2008) applied ANP to investigate customer preferences toward service quality and finally to determine the top hotel from the five hot spring hotels in Taiwan. Additional researches adopted ANP are (2008a), Lin et al. (2008b), and Lin et al. (2008c) and others.

Wen-Rong Jerry Ho, (2011) presented a novel MCDM model, including DEMATEL, ANP, and VIKOR for exploring portfolio selection based on CAPM. They probe into the influential factors and relative weights of risk-free rate, expected market return, and beta of the security. Their model examined leading semiconductor companies spanning the hottest sectors of integrated circuit (IC) design, wafer foundry, and IC packaging by experts. In the eight evaluation criteria, macroeconomic criterion was the most important factor affecting investment decisions, followed by exchange rate and firm-specific risk.

Chi-Yo Huang, et.al. (2012) researched on the smartphone operation system. OS is one of the major factors influencing consumers' purchase decisions toward purchasing smartphones. However, the analysis and predictions of consumer behaviors toward the smartphone OSs are not easy due to due to the fast emerging technology and highly competitive market situation. To resolve this problem, they aimed to propose a novel multiple criteria decision making (MCDM) based approach for discovering the factors influencing the technology acceptances of the smartphone OSs based on industry experts' opinions.

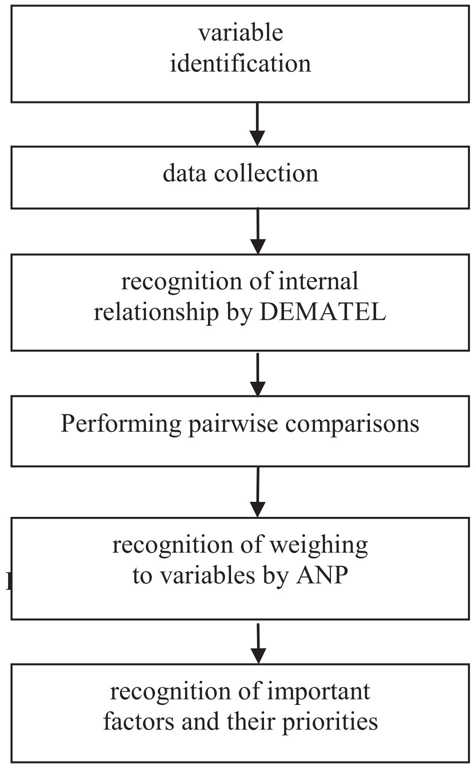
Chun-An Chen (2012) studied about the development of medical tourism in Taiwan by DEMATEL. DEMATEL method can confirm interrelationships among diverse factors and identify the key factors. This structure divided into five main aspects, including the strengthening of infrastructure and tourist services, the clarity of market segmentation, marketing planning, as well as government policy. The results show that the internet can provide detailed information on medical tourism and strengthen the marketing in order to develop medical tourism industry in Taiwan.

Since companies and organizations have grown to rely on their computer systems and networks, the issue of information security management has become more significant. To maintain their competitiveness, enterprises should safeguard their information and try to eliminate the risk of information being compromised or reduce this risk to an acceptable level. Yu-Ping Ou Yang (2013) proposed an information security risk-control assessment model that could improve information security for these companies and organizations. He proposed an MCDM model combining VIKOR, DEMATEL, and ANP to solve the problem of conflicting criteria that show dependence and feedback. The results show that their proposed method can be effective in helping IT managers validate the effectiveness of their risk controls.

3. Methodology

In this section we will talk about theoretical foundations and generalities of the theory of DEMATEL and ANP.

General framework of the model which presented in this part is displayed in figure 1. The evaluation of variables is an important problem in statistical researches and the methods of machine learning. Feature selection algorithms choose more effective set of data matrix variables. In fact we attribute a degree to each variable that it is the indicator of effect rate of variable in group classification. Whatever the degree of a variable is more, that variable has more share in calculations [18]. In the present research the selection of features is performed by combining DEMATEL and ANP methods.



3-1 DEMATEL

DEMATEL method was originally developed from 1972 to 1979 by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva, with the purpose of studying the complex and intertwined problematic group. It has been widely accepted as one of the best tools to solve the cause and effect relationship among the evaluation criteria (Chiu et al., 2006, Liou et al., 2007, Tzeng et al., 2007, Wu and Lee, 2007, Lin and Tzeng, 2009). This method is applied to analyze and form the relationship of cause and effect among evaluation criteria (Yang et al., 2008) or to derive interrelationship among factors (Lin and Tzeng, 2009). Based on Yu and Tseng (2006), Liou, et al., (2007), Tzeng, et al., (2007), Yang, et al., (2008),Wu and Lee (2007), Shieh et al., (2010 [Detcharat Sumrit a, and Pongpun Anuntavoranich, 2013].

Calculation steps of DEMATEL:

The DEMATEL method can be summarized in the following steps:

Step 1*:* Find the average matrix. Suppose we have *H* experts in this study and *n* factors to consider. Each stakeholder is asked to indicate the degree to which he or she believes a factor *i* affects factor *j*. These pairwise comparisons between any two factors are denoted by a_{ij} and are given an integer score ranging from 0, 1, 2, 3, and 4, representing 'No influence (0),' 'Low influence (1),' 'Medium influence (2),' 'High influence (3),' and 'Very high influence (4),' respectively. The scores by each expert will give us a *n* x *n* non-negative answer matrix $\boldsymbol{X}^k$ =[x_{ij}^k], with $1 \le k \le H$. Thus X^1, X^2,…, X^H are the answer matrices for each of the *H* experts, and each element of X^k is an integer denoted by x_{ij}^k. The diagonal elements of each answer matrix X^k are all set to zero. We can then compute the *n* x *n* average matrix ***A*** for all expert opinions by averaging the *H* experts' scores as follows:

$$a_{ij} = \frac{1}{H} \sum_{k=1}^{H} x_{ij}^k \qquad (1)$$

The average matrix ***A*=[** a_{ij}] is also called the initial direct relation matrix. ***A*** shows the initial direct effects that a factor exerts on and receives from other factors. Furthermore, we can map out the causal effect between each pair of factors in a system by drawing an influence map. Figure 2 below is an example of such an influence map.

Here each letter represents a factor in the system. An arrow from *c* to *d* shows the effect that *c* has on *d*, and the strength of its effect is 4. DEMATEL can convert the structural relations among the factors of a system into an intelligible map of the system.

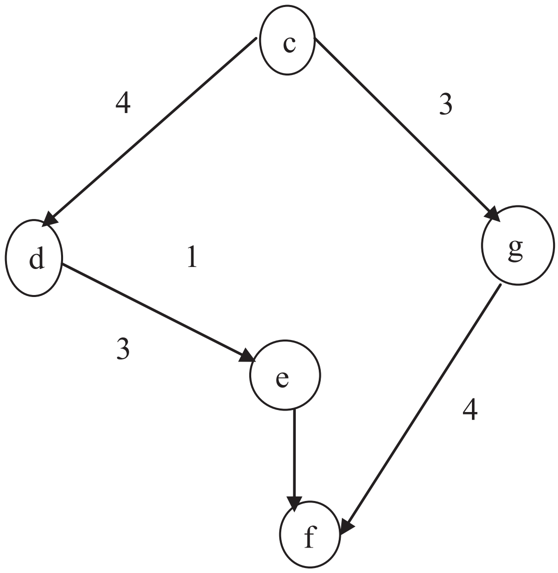


Figure 2: example flounce of map

Step 2: *Calculate the normalized initial direct-relation matrix*. The normalized initial direct-relation matrix ***D*** is obtained by normalizing the average matrix ***A*** in the following way:

$$\text{let} \quad s = \max\left(\max_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}, \max_{1 \le j \le n} \sum_{i=1}^{n} a_{ij} \right) \qquad (2)$$

$$\text{then} \quad D = \frac{A}{s} \qquad (3)$$

Since the sum of each row *j* of matrix ***A*** represents the total direct effects that factor *i* gives to the other factors, $\max_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}$ represents the total direct effects of the factor with the most direct effects on others. Likewise, since the sum of each column *i* of matrix ***A*** represents the total direct effects received by factor *i*, $\max_{1 \le j \le n} \sum_{i=1}^{n} a_{ij}$ represents the total direct effects received of the factor that receives the most direct effects from others. The positive scalar *s* takes the lesser of the two as the upper bound, and the matrix ***D*** is obtained by dividing each element of ***A*** by the scalar *s*. Note that each element d_{ij} of matrix ***D*** is between zero and less than 1.

Step 3: *Compute the total relation matrix.* A continuous decrease of the indirect effects of problems along the powers of matrix ***D***, e.g. $\boldsymbol{D}^2, \boldsymbol{D}^3, \ldots, \boldsymbol{D}^\infty$, guarantees convergent solutions to the matrix inversion similar to an absorbing Markov chain matrix. Note that $\lim_{m \to \infty} \boldsymbol{D}^m = [0]_{n \times n}$ and $\lim_{m \to \infty} (\boldsymbol{I} + \boldsymbol{D} + \boldsymbol{D}^2 + \boldsymbol{D}^3 + \ldots + \boldsymbol{D}^m) = (\boldsymbol{I} - \boldsymbol{D})^{-1}$, where *0* is the *n* ×*n* null matrix and *I* is the *n x n* identity matrix. The total relation matrix ***T*** is an *n*× *n* matrix and is defined as follow:

$$\boldsymbol{T} = [t_{ij}] \quad i, j = 1, 2, \ldots, n$$

where $\boldsymbol{T} = \boldsymbol{D} + \boldsymbol{D}^2 + \ldots + \boldsymbol{D}^{\boldsymbol{m}} = \boldsymbol{D} + \boldsymbol{D}^2 + \ldots + \boldsymbol{D}^{\mathrm{m}} = \boldsymbol{D}(I + \boldsymbol{D} + \boldsymbol{D}^2 + \ldots + \boldsymbol{D}^{m-1})$

$$= \boldsymbol{D}[(I+\boldsymbol{D}+\boldsymbol{D}^2+\ldots+\boldsymbol{D}^{m-1})(1-\boldsymbol{D})](1-\boldsymbol{D})^{-1} = \boldsymbol{D}(\boldsymbol{I}-\boldsymbol{D})^{-1}, \text{ as } m\rightarrow\infty \quad (4)$$

We also define ***r*** and ***c*** as *n* x *1* vectors representing the sum of rows and sum of columns of the total relation matrix ***T*** as follows:

$$r=[r_i]_{n\times i} = (\textstyle\sum_{j=1}^{n} t_{ij})_{n\times i} \quad (5)$$

$$\boldsymbol{c} = [c_j]'_{1\times n} = \left(\sum_{i=1}^{n} t_{ij}\right)'_{1\times n} \quad (6)$$

where superscript $'$ denotes transpose.
Let r_i be the sum of *i*-th row in matrix ***T***. Then r_i shows the total effects, both direct and indirect, given by factor *i* to the other factors. Let c_j denotes the sum of *j*-th column in matrix ***T***. Then c_j shows the total effects, both direct and indirect, received by factor *j* from the other factors. Thus when $j = i$, the sum (r_i+c_i) gives us an index representing the total effects both given and received by factor *i*. In other words, (r_i+c_i) shows the degree of importance (total sum of effects given and received) that factor *i* plays in the system. In addition, the difference $(r_i - c_i)$ shows the net effect that factor *i* contributes to the system. When $(r_i - c_i)$ is positive, factor *i* is a net causer, and when $(r_i - c_i)$ is negative, factor *i* is a net receiver (Tzeng et al. 2007; Tamura et al., 2002).
Step 4: *Set a threshold value and obtain the impact-relations-map.* In order to explain the structural relation among the factors while keeping the complexity of the system to a manageable level, it is necessary to set a threshold value *p* to filter out some negligible effects in matrix ***T***. While each factor of matrix ***T*** provides information on how one factor affects another, the decision-maker must set a threshold value in order to reduce the complexity of the structural relation model implicit in matrix ***T***. Only some factors, whose effect in matrix ***T*** is greater than the threshold value, should be chosen and shown in an impact-relations-map (IRM) (Tzeng et al., 2007).

Step 5: Build a cause and effect relationship diagram
The cause and effect diagram is constructed by mapping all coordinate sets of $(r_i + c_i, r_i - c_i)$ to visualize the complex interrelationship and provide information to judge which are the most important factors and how influence affected factors (Shieh et al., 2010). The factors that t_{ij} is greater than α, are selected shown in cause and effect diagram (Yang et al., 2008).

3-2. ANP
Saaty (1999) demonstrated several types of ANP models, such as the Hamburger Model the Car Purchase BCR model, and the National Missile Defense model. This kind of model can effectively capture the complex effects of interplay in human society, especially when risk and uncertainty are involved Saaty (2003). However, paper suggests a modified feedback system model Fig. 3) that allows inner dependences within the criteria cluster, in which the looped are signifies. The inner dependences of this study involves numbers of pairwise comparison for deriving the priorities of different alternative evaluation. Synthesizing experts' opinions is in compliance with the geometric mean method Buckley (1985). The valuation scales used in the study are those recommended by Saaty (1996 ,1980) ,where 1 is equal importance, 3 is moderate importance, 5 is strong importance, 7 is very strong or demonstrated importance, and 9 is extreme importance. Even numbered values will fall in between importance levels. Reciprocal values (e.g. 1/3, 1/5, etc.) mean less importance, even less importance, etc.

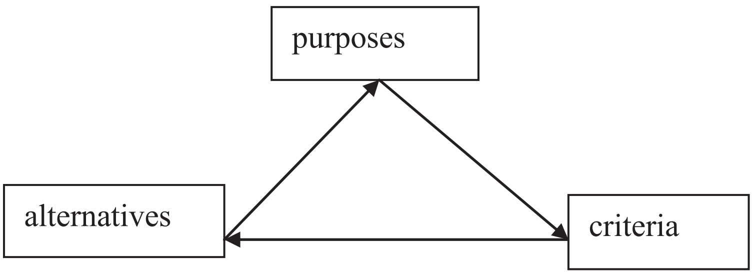


Figure 3: Study feedback system model

Saaty (1980) proved that for consistent reciprocal matrix, the λ_{max} value is equal to the number of comparisons, or $\lambda_{max} = n$. A measure of consistency was given, called Consistency Index as deviation or degree of consistency using the following formula. If the value of C.I. Ratio C.I. $=(\lambda_{max} - n)/(n-1)$ is smaller or equal to 10%, the inconsistency is acceptable. If the C.I. ratio is greater than 10%, the subjective judgment needs to be revised. n in the formula denotes the number of elements that have been compared. When $\lambda_{max} = 0$, the complete consistency exists within judgment procedures and then $\lambda_{max} = n$. The consistency ratio (C.R.) of C.I. to the mean random consistency index (R.I.) is expressed as C.R. (C.R. = C.I./ R.I.) less than 0.1. Saaty randomly generated reciprocal matrix using scale 1/9, 1/8, 1/7, ...1,...., 8, 9 (similar to the idea of Bootstrap) and took the random C.I. to see if it was about 10% or less. After eigen-vector decomposed, the priority weights in the same hierarchy are computed through normalization. The normalized weight vectors are $W = (x_1, x_2,....., x_n)$. The outcome of the process above is able to compose an unweighted supermatrix. Its columns contain the priorities derived from the pairwise comparisons of the elements. In an unweighted supermatrix, its columns may not be column stochastic. To obtain a stochastic matrix, i.e., each column sums to one, the blocks of the unweighted supermatrix should be multiplied by the corresponding cluster priority. The supermatrix should then be raised to a large power to capture first, second, and third degree influences. When the differences between corresponding elements of a column are less than a very small number, for successive powers of the supermatrix, the process has converged. To derive the overall priorities of elements, this method involves multiplying submatrices numerous times in turn, until the columns stabilize and become identical in each block of submatrices. The research model requires adjusting of the unweighted supermatrix to keep it column stochastic because it involves inner dependences and interdependency in the element clusters, The weighted supermatrix (the adjusted unweighted supermatrix) can then be raised to limiting powers to calculate the overall priority weights. The ANP employs the limiting process method $\lim_{k\to\infty} W^k$ of the powers of the supermatrix (Saaty 1996; Meade and Sarkis 1998; Sekitani and Takahashi 2001; Tseng et al. 2008). For synthesizing overall priorities for the alternatives, the unweighted supermatrix requires adjusting in order to keep it column stochastic (Sarkis 1999). The weighted supermatrix (the adjusted unweighted supermatrix) can be raised to limiting powers to calculate the overall priorities. However, before forming the unweighted supermatrix, the treatment of inner dependences needs to employ the DEMATEL. The treatment of inner dependences can theoretically use the ANP, but DEMATEL might be a better option as it can produce more valuable information for making decisions.

3-3. Data Gathering

Database including 325 cases of asthmatic and non-asthmatic diseases is collected by referring to Tehran Masih Daneshvari subspecialty hospital in the year 90-91. All numbers and weights which are used in ANP and DEMATEL techniques are collected by specialty physicians of asthma and allergy of Masih daneshvari hospital. Effective variables in asthma disease are recognized by using performed articles, book studies in related field and also by using experts' opinion. Variables in medical background classes of the person are divided into environmental factors, Allergy, genetic factors and social factors. At last recognized variables in five groups are presented in figure 4.

***3-4.** Result of DEMATEL*

The steps of DEMATEL method is transcribed by software R. For finding direct relations of variables, five experts expressed their ideas by scale 0 to 4 (for consensus, the median of numbers is considered). The matrix of direct and indirect relative relations in table 1 showed the relations among criteria. The number of lines and columns is indicator of variables that presented in figure 3.

Table 1: The direct and indirect relation matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.011	0.0042	0.005	0.032	0.002027	0.067	0.01	6.17E-	0	6.30E-	6.36E-	3.15E-
2	0.013	0.0091	0.006	5E-	7.99E-05	0.037	0	7.11E-	0	7.27E-	7.33E-	3.63E-
3	0.035	0.0074	0.02	0.009	0.009834	0.052	0.04	1.28E-	0	0.00013	1.32E-	6.52E-
4	0.104	0.0343	0.035	0.005	0.063162	0.044	0.04	4.39E-	0	4.49E-	4.53E-	2.24E-
5	0.071	0.0332	0.036	0.034	0.00244	0.041	0	4.49E-	0	4.59E-	4.63E-	2.29E-
6	0.04	0.0004	0.005	0.001	0.000127	0.007	0.06	6.19E-	0	6.32E-	6.38E-	3.16E-
7	0.069	0.0005	0.005	0.002	0.000185	0.039	0	6.41E-	0	6.55E-	6.61E-	3.27E-
8	0.106	0.0165	0.02	0.053	0.060354	0.063	0.01	0.00104	0	0.03547	0.03233	0.03233
9	0.103	0.016	0.02	0.052	0.057488	0.061	0.01	0.00104	0	0.03344	0.03232	7.01E-
10	0.061	0.0126	0.013	0.046	0.051105	0.052	0.01	0.00098	0	0.00397	0.00101	0.00102
11	0.041	0.0031	0.004	0.005	0.037548	0.009	0	0.00098	0	0.002	0.00101	3.40E-
12	0.043	0.0036	0.005	0.006	0.040049	0.01	0	1.92E-	0	0.00196	1.98E-	0.00098

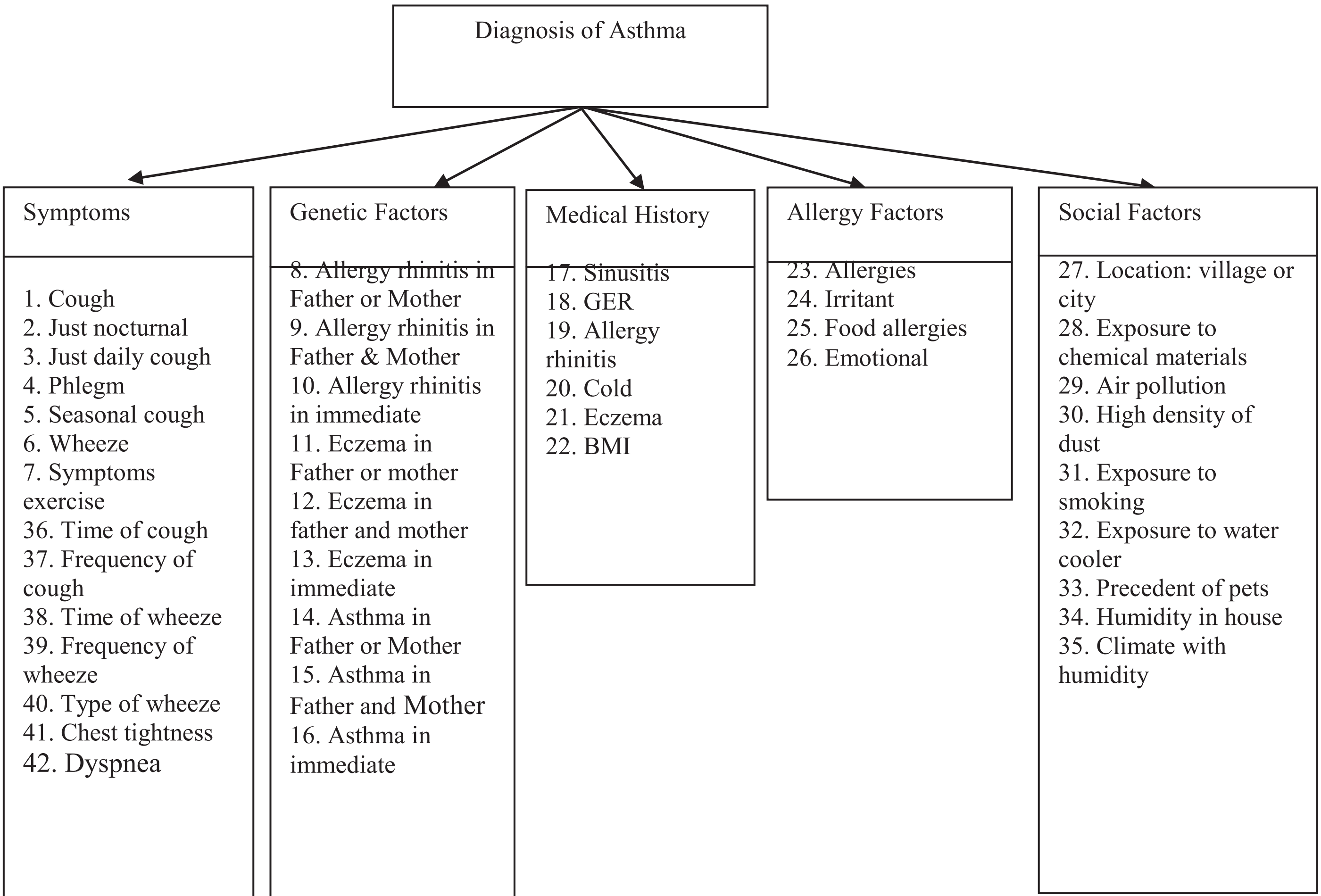


Figure 4: Variables of Asthma

…at… …sented in table 2. Yellow cells show the presence of relations among …e number of line and column shows disease variables. The efficiency of line factor towards … is considered in this table. For instance the cough variable has relationship with Just daily cough, …al cough, Wheeze, Symptoms exercise, Allergy rhinitis in Father or Mother, Allergy rhinitis in …er, Allergy rhinitis in immediate and Eczema in Father or mother.

Table 2: The inner relations variables

	1	2	3	4	5	6	7	8	9	10	11	12
1			■	■	■	■	■	■	■	■	■	
2				■	■				■	■		
3				■	■				■	■		
4	■				■				■	■	■	
5				■					■	■	■	■
6				■	■		■	■	■	■		
7		■		■		■						
10									■	■		
11									■	■		
12									■			

Threshold= /01516212

3-5. RESULT OF ANP

Pairwise comparison table filling by experts is analyzed by Expert choice software. Then supermatrix ANP is made and variable weights achieved according noted steps. Harmonic supermatrix based on table 3 is achieved by normalizing the column of primitive matrix so that sum of each column is one. Also this step is transcribed by software R.
By exponentiation of harmonic matrix, we had limited matrix that all numbers of each line of this matrix are equal and finally these numbers show variables' weights. Limited matrix is presented in table 4 (this stage is transcribed in software R). Now we have priority of criteria based on achieved weights. Each variable is in high priority if it has maximum weight. Finally priority variables are presented in table 5.

Table 3: Weighted Matrix

	Goal	A	B	C	D	E	1	2	3	4
Goal	0.192913	0	0	0	0	0	0	0	0.045045	0
A	0.098425	0	0	0	0	0	0	0	0	0
B	0.098425	0	0	0	0	0.01	0	0	0	0
C	0.061024	0	0	0	0	0.099	0.059252	0.175	0	0.010771
D	0.139764	0	0	0	0	0.058	0.059252	0.078	0.043043	0
E	0.314961	0	0	0	0	0.069	0	0	0	0
1	0.07874	0	0	0	0	0.012	0	0	0	0
2	0	0.088088	0	0	0	0.022	0.055094	0.043	0.044044	0.024943
3	0	0.141141	0	0	0	0.041	0.071726	0.061	0.078078	0.481859
4	0	0.068068	0	0	0	0.029	0	0	0.052052	0.022676

Table 4: The Limited Matrix

5.

	Goal	A	B	C	D	E	1	2	3
Goal	0.025118	0.025118	0.025118	0.025118	0.025118	0.025118	0.025118	0.025118	0.025118
A	0.018387	0.018387	0.018387	0.018387	0.018387	0.018387	0.018387	0.018387	0.018387
B	0.029058	0.029058	0.029058	0.029058	0.029058	0.029058	0.029058	0.029058	0.029058
C	0.021002	0.021002	0.021002	0.021002	0.021002	0.021002	0.021002	0.021002	0.021002
D	0.021414	0.021414	0.021414	0.021414	0.021414	0.021414	0.021414	0.021414	0.021414
E	0.041778	0.041778	0.041778	0.041778	0.041778	0.041778	0.041778	0.041778	0.041778
1	0.005109	0.005109	0.005109	0.005109	0.005109	0.005109	0.005109	0.005109	0.005109
2	0.062946	0.062946	0.062946	0.062946	0.062946	0.062946	0.062946	0.062946	0.062946
3	0.122532	0.122532	0.122532	0.122532	0.122532	0.122532	0.122532	0.122532	0.122532

Conclusion

Prevalence increase of asthma causes world consideration to asthma researches. We can improve people and patients intelligence by better recognition of disease mechanisms on asthma and effective relations in asthma effective variables and also recognition of the most important ones that it causes the control of disease symptoms, correct recognition and suitable cure of asthma. In this research the relations among variables achieved by using DEMATEL technique and we weighed to variables by using ANP method that variables had priority based on present weights. According to previous studies, the most important variables of asthma disease in Iran country are genetic factors of individuals, wheeze and environmental pollution.

6. Suggestions for future Studies

1. Since the opinions of physicians express in descriptive and qualitative mode, but it is proposed that we used fuzzy DEMATEL and ANP methods for receiving better results.

2. This method is investigated on non- adult asthmatic patients.

3. We can establish internal relationship of variables by meta-analysis method. In this method we can receive the relationship of variables based on articles and documents.

Table 5: Rank of Features

Rank of features
Precedent allergic rhinits in father and mother
Precedent asthma in father and mother
Precedent allergic rhinits in father or mother
Precedent allergic rhinits in immediate relatives
Precedent asthma in father or mother
Precedent eczema in father and mother
Wheeze
High density of dust in environment (sand storm)
Precedent of pets
Air pollution
Allergy rhinits
Sinusitis
Allergies
GER
Precedent asthma in immediate relatives
Irritants

Phlegm
Exposure to cooler or gas
Exposure to smoking now
Seasonal cough
Cold
Precedent eczema in father or mother
Precedent eczema in immediate relatives
Food allergy
Cough
Eczema
Exposure to chemical substance
Emotional symptoms
Symptoms exercise
Just nocturnal cough
BMI
Humidity in house
Just daily cough
Type of wheeze
Chest tightness
Time of cough
Frequency of cough
Time of wheeze
Frequency of wheeze
Climate with humidity
Dyspnoea

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