Averroes European Medical Journal
Open Access Publisher
ISSN: 0772-9200

JULY 2017 • Volume 3 • Number 2

# *Tobacco as a risk factor of larynx cancer: Artificial neural network modeling*

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**Background**: Several factors are involved in the development of laryngeal cancer. Tobacco is considered a major factor. However, the effect of these factors and the weight of each factor vary from one person to another. As far as human physiological functions are concerned, the processes are very complex. The analysis of these data remains very complex and very difficult if it is impossible to process them using the classical mathematical tool. This study proposes the application of a tool based on the principles of artificial intelligence, including artificial neural networks.
**Material and Methods:** This study included several factors are involved in the development of laryngeal cancer. Tobacco is considered a major factor. From the cases recorded in the district of Setif in Algeria during a decade. An artificial neural network model is proposed in the data analysis.
**Results**: the proposed artificial neural network system can bypass all complexity and constitute a prevention tool. The constructed system consists of seven layers of input layer (Age, year), hidden layer and an output layer expressing the number of cases recorded with laryngeal cancer.
**Conclusion**: The parameters related to the recorded subjects are considered as input factors to the system the number of cases recorded is considered as output variable. The system establishes a function of correspondence between the inputs and the output from the learning phase of the network. This makes it possible to introduce random variables at the inputs of the system to read instantly and with great precision the probable number of cases at the output. This tool can be a means of preventing this cancer. The system is able to manage all the complexity related to the phenomenon and therefore to predict the appearance of this type of cancer.

**Keywords**: Tobacco, larynx cancer, risk factors, artificial intelligence, artificial neural networks

## Introduction

There are many risk factors for laryngeal and pharyngeal cancer. The most important factor is related to tobacco consumption. All the studies are unanimous on this point. Tobacco is considered to be the cause of several types of cancer. The sites most exposed to tobacco-related carcinogenicity were lung cancer, oral cavity, pharynx, and larynx[1]. In this study, we limit ourselves just for laryngeal cancer. Based on the results of the various studies, there is indisputable evidence that links tobacco consumption with lung cancer, respiratory diseases, low birth weight and weight-bearing diseases and diseases of the oral cavity. An international group of scientists reports the association between tobacco and cancer; this is presented in a report with evidence of this. Overall, these types of cancers involve the nasal cavity, the sinuses, and the nasopharynx...etc[2].

Nasopharyngeal carcinomas vary according to geographical area. It differs mainly in North Africa and South-East Asia. Smokers are therefore at a higher risk than the rest of the population. Between the two sexes, this type of cancer is much more common in men than in women with proportions ranging from 3 to 1. Among the other factors determining age is considered a determining factor. Roughly speaking, the highest risk is in the population between 40 and 55 years of age and the lowest risk is in the population aged between 15 and 24 and 65-79 years. In any event, the International Agency for Research on Cancer classifies tobacco as a Group 1 carcinogen[3]. Despite evidence reported on the involvement of smoking on different types of respiratory cancers, studies are unable to provide evidence of its involvement in nasopharyngeal cancer. Bout studies of the control cases in the USA show a significant association between smoking and this type of cancer.

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Averroes European Medical Journal
Open Access Publisher
ISSN: 0772-9200



This can be explained by the involvement of other risk factors[4]. Attempts to analyze the risk factors for this type of cancer are very approximate given the complexity of the system. The factors involved are very varied, inaccurate and uncertain. Also, the predisposition of individuals is very complex to study considering the differences related to human physiology. In this study, an artificial neural network system is proposed in the analysis of certain variables that constitute risk factors for the development of laryngeal cancer. The proposed system has seven inputs (Age, year, gender, crude rate, ASR(WR), Cum incidence, % on total cancers and median age) and one output that express the degree of involvement of this type of cancer. The ultimate objective is to circumvent the inaccuracies and complexity of the analysis of factors related to this type of cancer by using an artificial neural network system.

**Tobacco as a larynx cancer factor**

The consummation of the tobacco scourge is the most important factor in global mortality. About six million people die each year from tobacco. The toxic substances of tobacco are around 7000 substances. About fifty substances are directly related to cancers[5]. Even smokeless tobaccos are also a source of carcinogenic causes. But probably the risk is much lower than that in smokers[6]. All evidence is available to confirm that smoking is associated with laryngeal cancer and this is well established. What is also noticed is that its distribution varies as well as the survival of the people concerned[7]. The association of laryngeal cancer with tobacco is evident for a person who smokes for a period of more than 15 years at a rate of 15 cigarettes per day[8]. In cases where smoking is associated with alcohol consumption, the risk factor is increased[9].

The action of tobacco toxic substances is affecting DNA gene mutations in oncogenes and genes that are considered as cancer suppressants have been established in the case of lung cancer and neck. Inhalation of tobacco smoke in laboratory animals has produced oxidative damage in carcinogenesis by their free radicals[10]. It can also be noted that laryngeal epidermal carcinoma is associated with tobacco consumption[11].

**Artificial Neural Networks**

Biology has brought a lot of information on the functioning of the brain, neurons…etc. Mathematicians then tried to reproduce the functioning of the brain by integrating this knowledge in biology into computer programs, and giving them the possibility of learns. Artificial neural networks currently find a variety of applications in the field of science and technology[12].Artificial neural networks have the dynamics and the ability to read experimental data from the real environment and are therefore able to solve the complex systems of biophysical processes[13]. Neural networks are systems learning to perform functions of mapping between two spaces, input space and output space. The application of connection techniques has made it possible to deal with problems of medical diagnosis in an emergency[14]. In this case, the network maps the starting space consisting of the symptoms to the output space composed of the possible diagnoses. The function associating the symptoms with the diagnostics is learned by the network from a set of real cases. In the case of analysis of risk factors for cancer, the proposed network allows the input space made up of these factors to be matched with the output space composed of the number of cases recorded or the degree of risk of this cancer. The main phase in the execution of the neural network is the learning phase by the network. From the reading of the recorded case table according to the factors taken into consideration, the network establishes the function that binds the inputs to the output by taking the lines one by one. The network starts by constructing a function linking the inputs to the output from the first line, passing to the next line, as variables varies; the network adjusts function by acting through the variation of the mathematical coefficients called weights. The remaining lines are used to test the function established in the learning phase. If the test values coincide with the learning values, the function is enabled and it will therefore be possible to enter random variables at the input to automatically and instantly read the output value. Whatever the complexity of the data and the number of variables processed, the neural network has the ability to handle this complexity with a high degree of accuracy.



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## Method

The data studied are the factors involved in the laryngeal cancer observed in smokers in the district of Setif in Algeria during the decade of 2000 to 2010. These factors are limited; we classified them by age and sex. The incidence of this cancer during this period is 332 cases divided into 290 cases in men and 42 cases in women. This is explained by the fact that men smoke more than women. Sociologically the women of this region do not smoke. This type of cancer is the second most common cancer location. The gross incidence rate per 100,000 habitants is 3.9 for men and 0.6 for women, while the standard incidence rate is 6,2 and 0.7 per 100,000 habitants (Table 1a, 1b).

Age distribution Laryngeal cancer is recorded in males from the age of 35 and its incidence gradually increases to reach its maximum at the age of 68 to 69 years.

**Table 1a.**Incidence of laryngeal cancer in men in Setif area - Algeria

| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of cases | 22 | 18 | 28 | 40 | 29 | 13 | 36 | 45 | 25 | 34 | 290 |
| Crude rate/100.000 | 3.2 | 2.6 | 3.9 | 5.5 | 4.0 | 1.8 | 4.8 | 5.9 | 3.2 | 4.3 | 3.9 |
| ASR (WR)/100.000 | 5.9 | 4.2 | 7.0 | 9.9 | 6.5 | 3.0 | 7.5 | 7.9 | 4.5 | 6.4 | 6.2 |
| 0-74Cum incidence (1%) | 0.5 | 0.4 | 0.9 | 1.3 | 0.9 | 0.4 | 0.9 | 0.9 | 0.5 | 1.0 | 0.3 |
| % on total cancers | 0.4 | 0.4 | 0.5 | 0.8 | 0.5 | 0.3 | 0.9 | 0.9 | 0.5 | 0.3 | 5.8 |
| Median Age | 59 | 63.5 | 64.5 | 65 | 66 | 65 | 57 | 54 | 56 | 66.5 | 63 |

**Table 1b.**Incidence of laryngeal cancer in women in Setif area - Algeria

| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of cases | 1 | 2 | 2 | 4 | 4 | 3 | 8 | 14 | 3 | 1 | 42 |
| Crude rate/100.000 | 0.1 | 0.3 | 0.3 | 0.6 | 0.6 | 0.4 | 1.1 | 1.9 | 0.4 | 0.1 | 0.6 |
| ASR (WR)/100.000 | 0.2 | 0.4 | 0.4 | 0.6 | 0.8 | 0.4 | 1.4 | 2.1 | 0.5 | 0.1 | 0.7 |
| 0-74Cum incidence (1%) | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.3 | 0.1 | 0.0 | 0.1 |
| % on total cancers | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.1 | 0.0 | 0.3 |
| Median Age | 65 | 44.5 | 72 | 34.5 | 50 | 35 | 50 | 51 | 41 | 81 | 50 |

## Results

The factors analyzed are for a population with laryngeal cancer over a period of 10 years. The statically variables related to these persons are calculated according to the number of cases recorded. What is found is that this cancer is more relevant in men than in women with a rate of seven times. The crude rate per 100.000, the percentage on total cancers, the median age…etc. for males and females. (Table 1a, 1b). The median age at diagnosis is 63 years (fig). From a diagnostic point of view, these tumors are of the 98% primary tumor type, whereas from a morphological aspect, 75% of these tumors are carcinomas where 54% are considered as sequestral cell carcinomas. In comparison with other countries, the region of Setif in Algeria has an incidence close to that of the industrialized countries.

In order to better refine the analysis and to make it more expressive, the proposed artificial neural network system can bypass all complexity and constitute a prevention tool.

The constructed system consists of sevenlayers of input layer (Age, year, gender, crude rate, ASR(WR), Cum incidence, % on total cancers and median age), hidden layer and an output layer expressing the number of cases recorded with laryngeal cancer (Figure 1).

The performance achieved at this level is 8.25 with a gradient of 7.10-6.

Error correction occurs after 200 iterations. The optimal result is achieved only after 32 iterations (Figure 2).

Where test results coincide with learning outcomes. The function linking the inputs to the output is therefore validated.



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Averroes European Medical Journal
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ISSN: 0772-9200

JULY 2017 • Volume 3 • Number 2

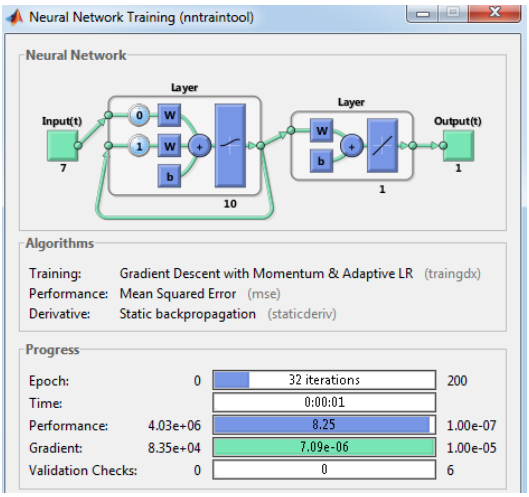


Fig. 1. Block diagram and analysis result

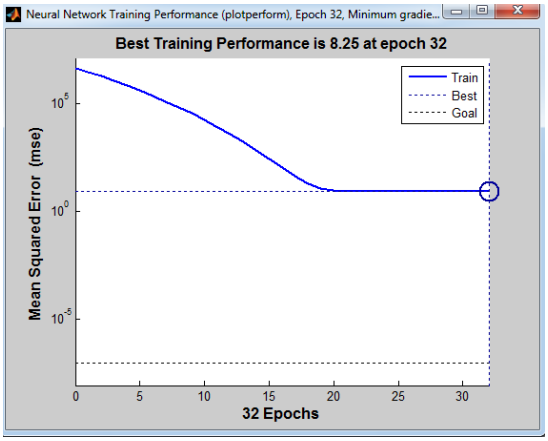


Fig. 2. Training performance

## Conclusion

In order to overcome the complexity of data analysis related to the nature of laryngeal cancer factors and to overcome the difficulties associated with classical statistical analyzes, a system based on the principles of artificial intelligence including artificial neural networks is proposed.Tobacco continues to be considered the primary factor involved in this type of cancer.The proposed study concerns registered cases of laryngeal cancer in the Setif region of Algeria for a decade. The parameters related to the recorded subjects are considered as input factors to the system the number of cases recorded is considered as output variable. The system establishes a function of correspondence between the inputs and the output from the learning phase of the network. This function is adjusted after 32 iterations to arrive at its optimum. The test values coincide perfectly with the learning values, which validates the established function. This makes it possible to introduce random variables at the inputs of the system to read instantly and with great precision the probable number of cases at the output. This tool can be a means of preventing this type of cancer.

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Open Access Publisher
ISSN: 0772-9200

JULY 2017 • Volume 3 • Number 2

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