
Prediction of Cancer: By Fuzzy AHP and TOPSIS

Methods

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Abstract.

Cancer is considered as one of the most dangerous diseases around the world, it is the one where the abnormal cells rapidly starts growing causing the neighbouring cells or the neighbouring organs, where the abnormal cells are also called as the tumours. In this paper aims to predict the probability of cancer using some of the fuzzy methods like the Fuzzy AHP (Analytical Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) methods. These methods are applied to a dataset which is taken from the Kaggle website, in this dataset includes attributes like smoking, genetic risk, chronic lung disease, air pollution, alcohol use or consumption. In this the first method used is the Fuzzy AHP method which ranks the importance of different criteria, here the smoking is the most important risk factor. The second method used is the TOPSIS method in this method the most important risk factor is smoking. This study helps us to understand that both the methods are effective in finding the cancer risk, while TOPSIS method is more advantageous over the AHP method for the quantitative analysis. The results show that smoking plays a most critical role in cancer prediction.

Keywords. Cancer prediction, cancer mortality, Fuzzy AHP, genetic predisposition, healthcare access, lifestyle factors.

1. INTRODUCTION

Cancer which is scientifically called as “Neoplasm” which basically means “New Growth” is one of the deadliest and life taking diseases in the world. The study and treatment of the cancer is generally called “Oncology” and the people responsible for treating this cancer are termed as “Oncologists”. [1] Cancer is mainly caused by carcinogenic cells also termed as the “Cancer Cells”. Such cells multiply in an exponential rate mainly causing tumours around the body organs which further on decrease the performance if that affected organ and even decrease the life expectancy of the organism affected. Such tumours are mainly classified into 2 types mainly Benign tumours and Malignant tumours. Among the above-mentioned tumours one of the dangerous tumours are “Malignant tumours” which are unlike “Benign tumours”. The main reason for their hazardousness is that they are not stagnant tumours like benign tumours and are constantly spreading all over the body and affecting the organs. There are more than 200 types of cancer present in the world. This study aligns with United Nations Sustainable Development Goal (SDG) 3, specifically Target 3.4 which aims to reduce premature mortality from non-communicable diseases including cancer.

2. RELATED WORK

Cancer is ranked as the 2nd most deadly disease responsible in loss of lives of many millions of people around the globe annually. It is said to believe that the life expectancy of a cancer patient is just around 5 years. [2] Based on the report produced by “The WHO” around 20 million new cancer cases are diagnosed with around 9.7 million deaths occurring annually all over the world. Based on the reports generated by “The International Agency for Research of Cancer (IARC)” which is official part of “The WHO” stated that “Pancreatic Cancer” was one of the major types of cancer that killed people much faster in an unprecedented rate and one of the most common types is the breast cancer in females. [3] In India around 850,00 people die annually to this deadly disease. Organizations like ICS, TMC and CPAA in India are constantly working in order to spread awareness on cancer and are even helping people in successfully treating cancer. [4] Based on the data reviewed by the WHO organization there has been an exponential increase in the deaths and has been a major concern in early diagnosis and prediction of whether a particular individual is affected by cancer. [10] The mortality rate due to cancer is around 146.0 per 1 lakh males and females. Around only 14% of cancers of the individuals living in the USA have been predicted. Some countries are unable to predict the cancer mainly due to 2 reasons: • Unaware of cancer disease. • Do not have the technology to detect cancer in an individual. [5] Due to the recent development in the areas of communication and other handheld gadgets, now it has become much easier to predict cancer in an individual. [6] Some of the different mobile applications mainly helping in such predictions are depicted in the Table I.

TABLE I. CANCER RELATED MOBILE APPLICATIONS

S. No.	Application Name	Description
1	Skin Vision	An AI based application detecting cancer by identifying lesions in the skin

2	Mole Mapper	Makes use of photographs and detects the moles and depicts the changes in Melatoma
3	. B4BC App	Mainly deals with the Breast cancer and helps in diagnosis
4	My Cancer Coach	Acts as a social app that helps in monitoring different individuals' stages of cancer
5	Breast cancer helpline	Connects users with other individuals facing breast cancer.

3. METHODOLOGY

We assume numerically for the pairwise comparison matrix as follows: Smoking: is 4 times more important than genetic risk. 3 times more important than Chronic lung disease. 6 times greater than air pollution. 5 times greater than alcohol use. Genetic risk: 3 times important than Chronic lung disease. 4 times important than air pollution. 3 times important than alcohol use. Chronic lung disease: 3 times important than air pollution. 4 times important than alcohol use. Air pollution: 4 times more important than alcohol use. The fuzzy geometric means are: Smoking (2.61,3.25,3.84), Genetic risk (1.19,1.55,1.93), Chronic Lung Disease (0.82,1.06,1.38), Air pollution (0.53,0.56,0.61), Alcohol use (0.31,0.33,0.38).

4. RESULTS

In fuzzy AHP method, based on the weights obtained we rank the alternative. The alternative with the highest weight is given rank 1 and so on as shown in Table II.

TABLE II. AHP RESULTS

Defuzzified Weights	Ranking
0.477	1
0.228	2
0.159	3
0.085	4
0.051	5

The value 0.477 with assigned rank value of 1 mainly corresponds to the attribute Smoking. Now moving forward with results of the TOPSIS method we again rank the closeness coefficients which are obtained as follows: $[0.460, 0.357, 0.527] = [2, 3, 1]$. A3 having the closeness coefficient of 0.527 is the best alternative. Now taking into consideration only the A3 alternative we get to know some key factors and can rank the criteria as follows: [Smoking, Genetic risk, Chronic Lung cancer, Air Pollution, Alcohol Use] = [1, 5, 2, 4, 3]. By the TOPSIS method too we get that smoking is one of the main causes for cancer.

5. CONCLUSION

We can conclude by Fuzzy AHP methods and TOPSIS methods "Smoking" is one of the most important criteria or the most cancer-causing factor present all over the world. By theory we can say that both the methods are equally important which is mainly based on the problem chosen and the type of data in it. The fuzzy AHP method performs very well if we have a complex decision problem with larger number of criteria to be considered and to be

ranked since AHP method can be used to handle such a large number of criteria by breaking them down into comparisons. Whereas the TOPSIS method mainly when we have a straightforward decision problem and even having quantitative data in it. In rare cases we have to use a combination of both these methods to obtain the best alternative. So thereby on the above-mentioned qualities of TOPSIS and AHP methods and by the dataset review discussed in the methodology section we get to know that AHP method serves as a best method to rank the alternatives. Hence “Smoking” is one of the important criteria to be noted down for cancer prediction.

6. REFERENCES

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