A Data-Driven Approach for Eye Disease Classification in Relation to Demographic and Weather Factors Using Computational Intelligence Software

Co-Authors:

Thomas Jefferson University, USA:

Amna Alalawi, Dr. Les Sztandera, PhD,& Parth Lalakia

LV Prasad Eye Institute, India:

Dr. Anthony Vipin & Gumpili Sai Prashanthi

Presented by Amna Alalawi

Significance of the Research

Being able to understand that we now live in a VUCA (*Volatile, Uncertain, Complex, Ambiguous*) world requires taking a holistic approach to studying patients' demographic and social influence in the development of diseases, in this case, ocular diseases.

The focus of the research is to study the socio-demographic and climatic factors that affect the development of eye disorders in Telangana.

Background

In 1976, India launched ‘Vision 2020, The Right to Sight’ a program aimed to reduce blindness prevalence to 0.3 percent by 2020. However, today the prevalence of blindness still stands at 1.99 percent, with over 8.3 million people with Vision Impairment (VI) in India [1][2].

It is therefore crucial to study the population of Telangana from a systematic approach to understand the relationship of socio-demographic and climatic factors in relation to ocular diseases.

Case Study

Analysis of a dataset consisting of approximately 1 million patients with eye disorders in Telangana who visited LV Prasad Eye Institute (LVPEI) from 2011-2019.

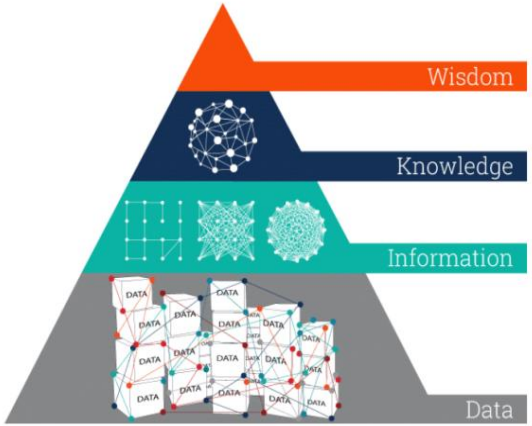
The Electronic Medical Record (EMR) management tool currently used to store LVPEI patient data is Eyesmart.

Data merging process was the main methodology used to include climatic variables and create a master data set for analysis. The climatic variables were obtained from the Telangana Planning and Development Society.

Research Question

Can data merging techniques be applied to EMRs to generate new knowledge shedding light on correlations between the development of eye disorders and socio-demographic and environmental factors among residents of Telangana?

DIKW Pyramid



Each step up the pyramid answers questions about and adds value to the initial data.

Knowledge Pyramid, Wisdom Hierarchy and Information Hierarchy are some of the names referring to the popular representation of the relationships between data, information, knowledge and wisdom in the *Data, Information, Knowledge, Wisdom (DIKW)* Pyramid.

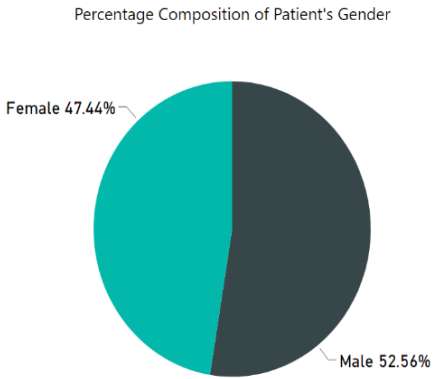
https://www.ontotext.com/knowledgehub/fundamentals/dikw-pyramid/

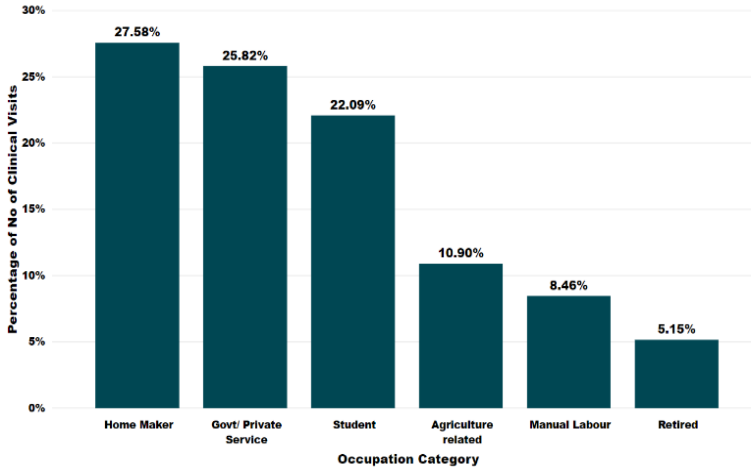
Methodology

For the data analysis, Python and Microsoft Power BI were used to merge and interpret the data and to generate graphics that can lead to new insights on the socio-demographic factors that lead to eye disorders.

The climatic variables chosen for testing are temperature, humidity, windspeed, rainfall and global radiation.

Findings


Percentage Composition of Patient's Gender
Female 47.44%
Male 52.56%

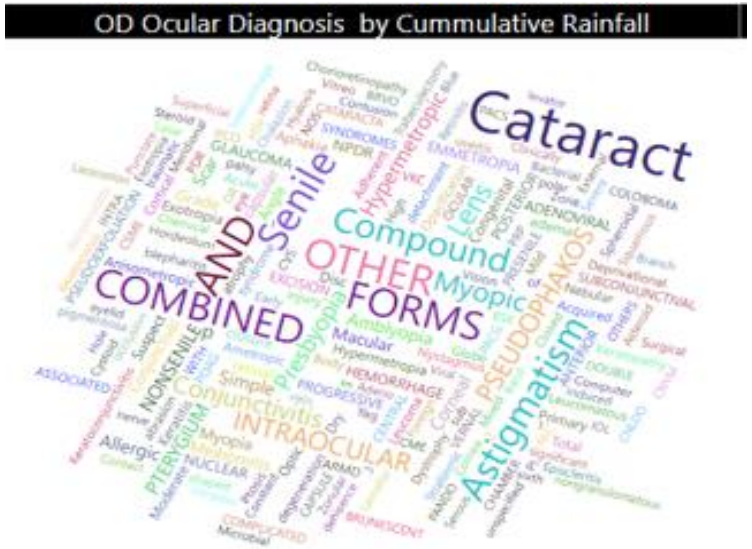

30%
25%
20%
15%
10%
5%
0%
Percentage of No of Clinical Visits
27.58%
25.82%
22.09%
10.90%
8.46%
5.15%
Home Maker
Govt/ Private Service
Student
Agriculture related
Manual Labour
Retired
Occupation Category

Findings

Eye disorders are mostly concentrated in residents from the district of Paloncha, and even though this district has a higher literacy rate than state average is 77%, 10% higher than that of the state average which is at 67%, it has been reported that it has been hit with pollution and contaminated water in 2015. The state-run thermal power plant installed in 2015 caused pollution and health disorders including eye disorders [3].

Findings

Cataract in Relation to Rainfall

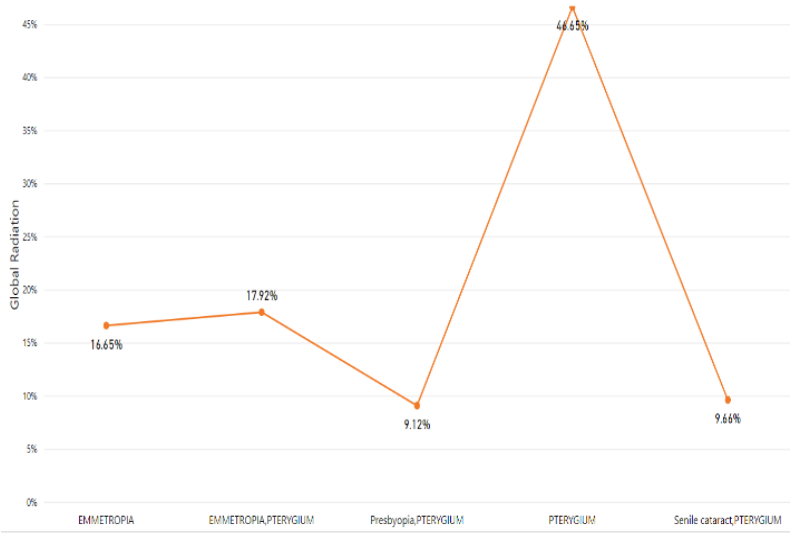


Cataract is the disease most prevalent in rainfall.

Globally, cataract is the single most important cause of blindness, and the second most common cause of moderate and severe vision impairment (MSVI) according to the Global Burden of Disease, Injuries and Risk Factors Study, and it is most predominant in Southeast Asia [4].

Findings

Pterygium in Relation to Global Radiation



Pterygium shows to be most prevalent at over 46% of the total global radiation value. The analysis was done on a patient basis and not a disease basis, as the data showed that one patient can develop more than one disease.

Summary

To transform EMR data into a more structured data that will yield knowledge innovation and aid decision making.

To find new information on the sample study, and to propose ways that can lead to early intervention to prevent the development of eye disorders in patients in Telangana.

Second Phase of the Research

The second phase of the research will be focused on examining cataract and pterygium as the main diseases for further exploration.

The aim is to find correlation between the climatic factors that affect the development of both cataract and pterygium in both the old and young population, which will offer a more comprehensive study.

References

[1] G. Rao, N. Khanna, and A. Payal, “The global burden of cataract,” Current Opinion in Ophthalmology, 22(1), 4-9, 2011.

[2] S. Marmamula, R. Khanna, and G. Rao, “Unilateral visual impairment in rural south India–Andhra Pradesh Eye Disease Study (APEDS)”, International Journal of Ophthalmology, 9(5), 763, 2016.

[3] Suchitra, 2015. Stream of Ash. Down to Earth https://www.downtoearth.org.in/coverage/stream-of-ash-44036

[4] S.G. Honavar, “Eliminating cataract blindness: Are we on target?” Indian Journal of Ophthalmology, 65(12), 1271, 2017.

Any Questions?

E-mail me at: amna.alalawi@jefferson.edu