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Correlation of Serum Electrolytes with Senile Cataract in Diabetic and Non-Diabetic Populations in Central India

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Abstract: ***The study investigates the correlation between serum electrolyte levels and senile cataract development in diabetic and non-diabetic individuals in Central India. It includes an observational analysis of 100 cataract patients over 40 years, examining serum electrolytes and glycemic control. The results indicate a moderate correlation between serum sodium levels and senile cataracts in diabetics, with sodium and potassium potentially serving as markers. This study underscores the importance of electrolyte management in cataract prevention, particularly in diabetic populations.***

Keywords: Cataract; Serum Electrolyte; HbA1c; Diabetes

1. Introduction

As Per the WHO, cataract blindness is projected to hit 40 million by 2025 due to aging populations and extended life spans.[1] A cataract, an opacification of the lens, results in a measurable decrease in visual acuity and/or perceived functional disability.[2] In India, cataracts account for 66.2% and 25% of blindness in individuals aged ≥ 50 and 0-49 years, respectively.[3] Any electrolyte imbalance can lead to a cationic imbalance in the lens, causing cataract formation. Cataract development is more frequent and occurs at a younger age in diabetics than in non-diabetic patients.[4,5]Thus, it is justified to attempt to identify potential risk factors for cataractogenesis via serum electrolyte levels.

2. Subjects and methods

We conducted an observational study to explore the correlation between serum electrolyte levels and cataract development. A diverse cohort of 100 subjects, both male and female, diagnosed with senile cataracts and scheduled for surgery, participated. Subjects were divided into two groups: 'Group A' (n=50) consisting of individuals with diabetes and 'Group B' (n=50) without diabetes. The study was conducted from April 2023 to May 2023.

Exclusion criteria included chronic kidney disease, previous ophthalmic surgeries, poorly controlled diabetes, traumatic, complicated, or steroid-induced cataracts. Ethical clearance was secured from the relevant institutional review board.

Participants were recruited and underwent surgery at the same institute. Blood samples were collected from the antecubital vein and analyzed using TRANSASIA EM 200 for serum electrolytes and ROCHE Cobas Integra 400 Plus for HbA1c. Results were documented in an MS Excel database, ensuring patient confidentiality. Informed consent was obtained from all participants, detailing study specifics and potential risks. Statistical analysis was performed using IBM SPSS v23, with Pearson's correlation coefficient determining the relationship between serum electrolytes and cataracts in both diabetic and non-diabetic subjects. The study design aimed to minimize bias, uphold ethical standards, and provide valuable insights into the proposed correlation.

3. Results

Table: Descriptives Statistics

Table 1 – (a): Group A + B	N	Minimum	Maximum	Mean ± Std. Deviation
Age		40	80	61.56 ± 10.22
Sodium		134.30	150.30	142.31 ± 3.89
Potassium		3.44	5.40	4.25 ± 0.45
HbA1c levels		4.80	7.10	5.91 ± 0.73
Total(N)	100	Females	48	Males 52
Table 1 – (b): Group A	**N**	**Minimum**	**Maximum**	**Mean ± Std. Deviation**
Age		40	80	61.62 ± 11.25
Sodium		134.30	150.30	141.15 ± 4.06
Potassium		3.44	4.99	4.16 ± 0.43
HbA1c levels		6.10	7.10	6.56 ± 0.35
Total(N)	50	Females	26	Males 24
Table 1 – (c):	**N**	**Minimum**	**Maximum**	**Mean ± Std.**

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Group B				Deviation	
Age		42	79	61.5 ± 9.19	
Sodium		135.50	150.00	143.47 ± 3.38	
Potassium		3.56	5.40	4.35 ± 0.44	
HbA1c levels		4.80	5.70	5.26 ± 0.29	
Total(N)	50	Females	22	Males	28

The descriptive statistics of all participants (n=100) are presented in Table 1- (a), while group-wise statistics for Group A – subjects with Diabetes and Group B – subjects without Diabetes are in Table 1- (b) and Table 1- (c) respectively.

For analysis, HbA1c levels were divided into 3 categories:

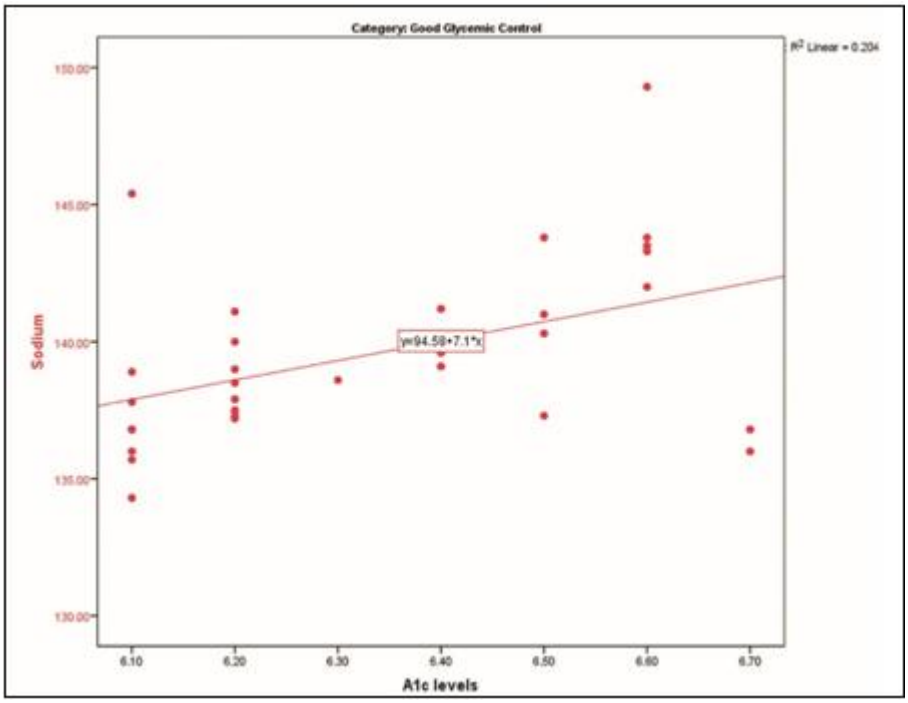
- HbA1c % ≤ 6.0 – Normal / Non–Diabetic – Group B
- HbA1c % 6.1 – 6.7 – Good Glycemic Control – Group A
- HbA1c % 6.8 – 7.65 – Fair Glycemic Control – Group A

The frequencies were 50 (28 males and 22 females) in normal/ non-diabetic, 31 (14 males and 17 females) in good glycemic control, and 19 (10 males and 9 females) in fair glycemic control respectively.

Pearson's correlational test was performed to analyze the association between serum sodium, serum potassium, and glycemic control (HbA1c). The analysis of 'GROUP A' indicated a moderate correlation between serum sodium levels and glycemic control with senile cataracts (pearson's r = .531, p ≤ .01),[6] and a moderate correlation between serum potassium levels and glycemic control with senile cataract (pearson's r = .331, p=.019) [6]

Upon examining the subcategories, In the good glycemic control subcategory, a moderate correlation was found between serum sodium levels and good glycemic control with senile cataracts (pearson's r = .452, p = .011).[6]

However, the correlation between serum potassium levels and good glycemic control with senile cataract was negatively weak (pearson's r = -.153, p =.412).[6]



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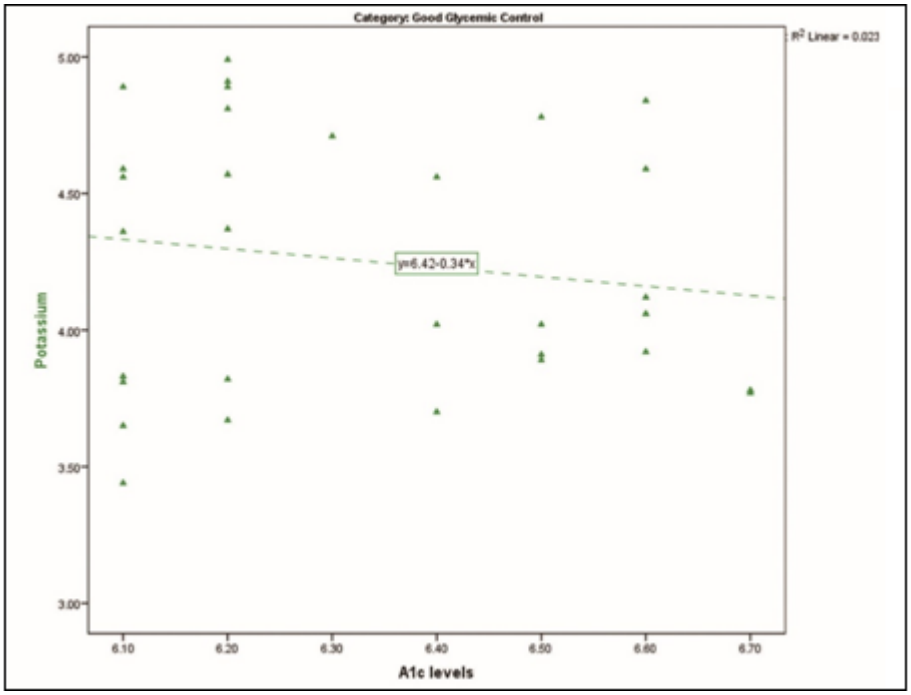
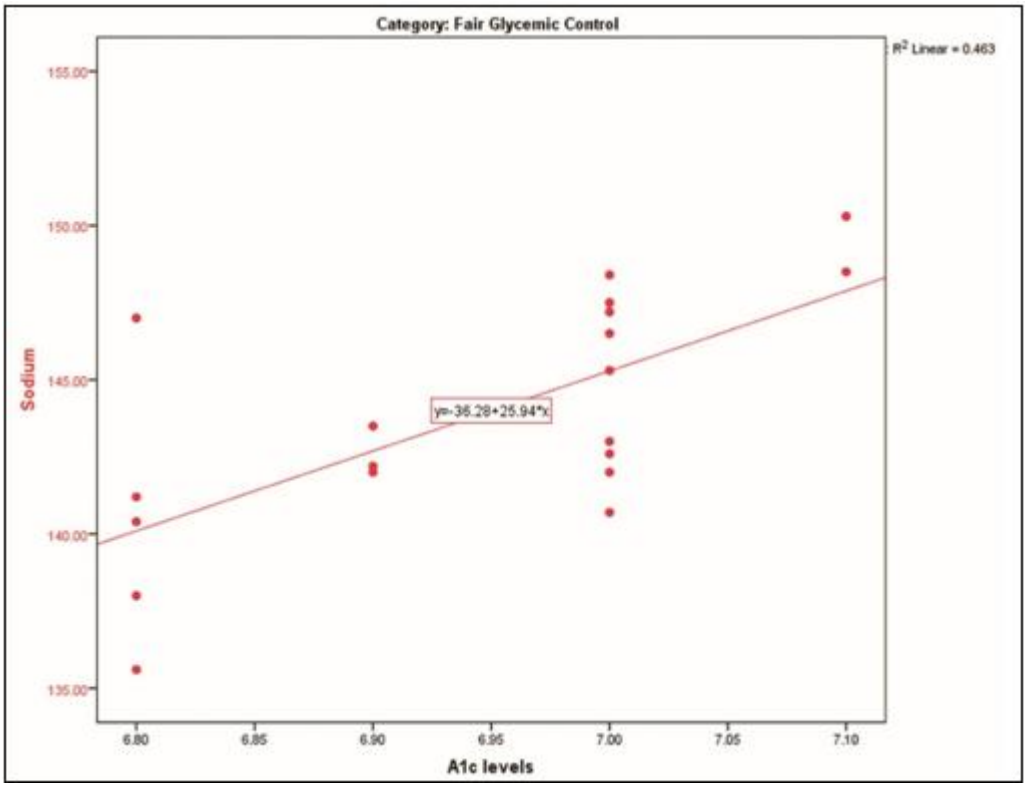


Graph 1: Good glycemic control, senile cataract

In the fair glycemic control subcategory, a moderate correlation was found between serum sodium levels and fair glycemic control with senile cataract (pearson's r = .681, p ≤.01),[6]and a negatively moderate correlation was found between serum potassium levels and fair glycemic control with senile cataract (pearson's r = -.475, p = .04).[6]



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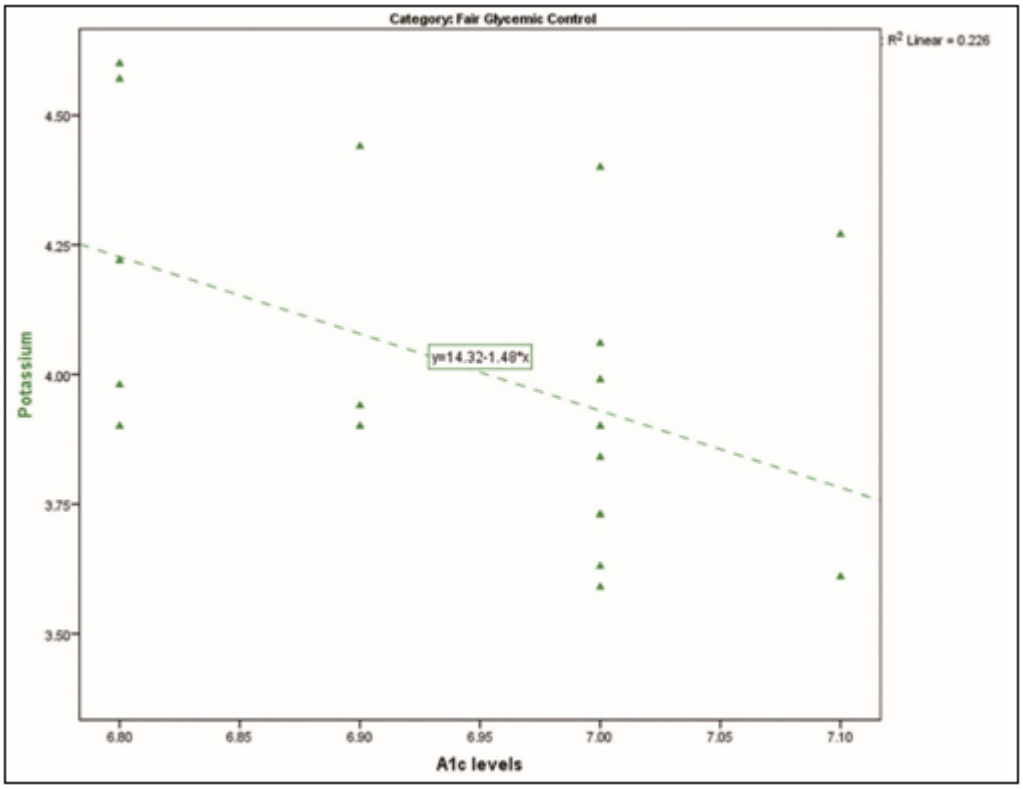
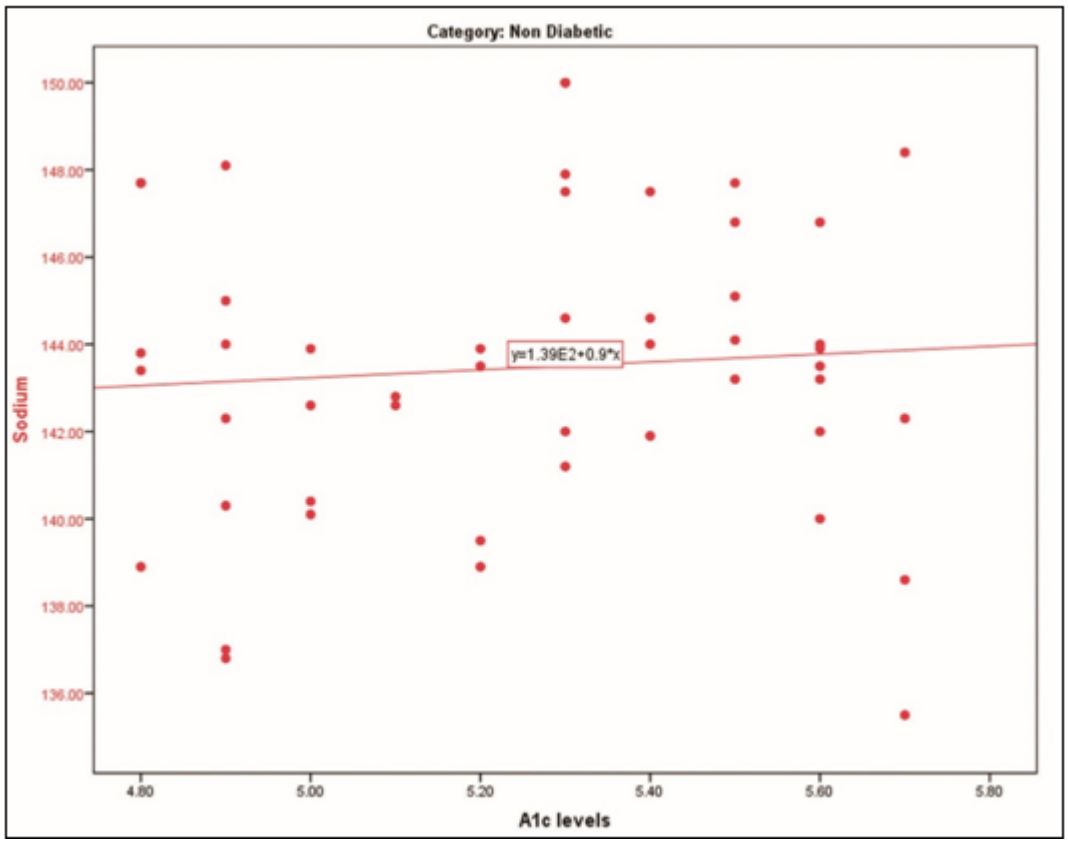


Graph 2: Fair glycemic control, senile cataract

In 'group b', the correlation with non-diabetics with senile cataract with sodium and potassium was found to be statistically not significant (r= -.079, p=.588 for sodium and r= .107, p=.46 for potassium respectively).[6]



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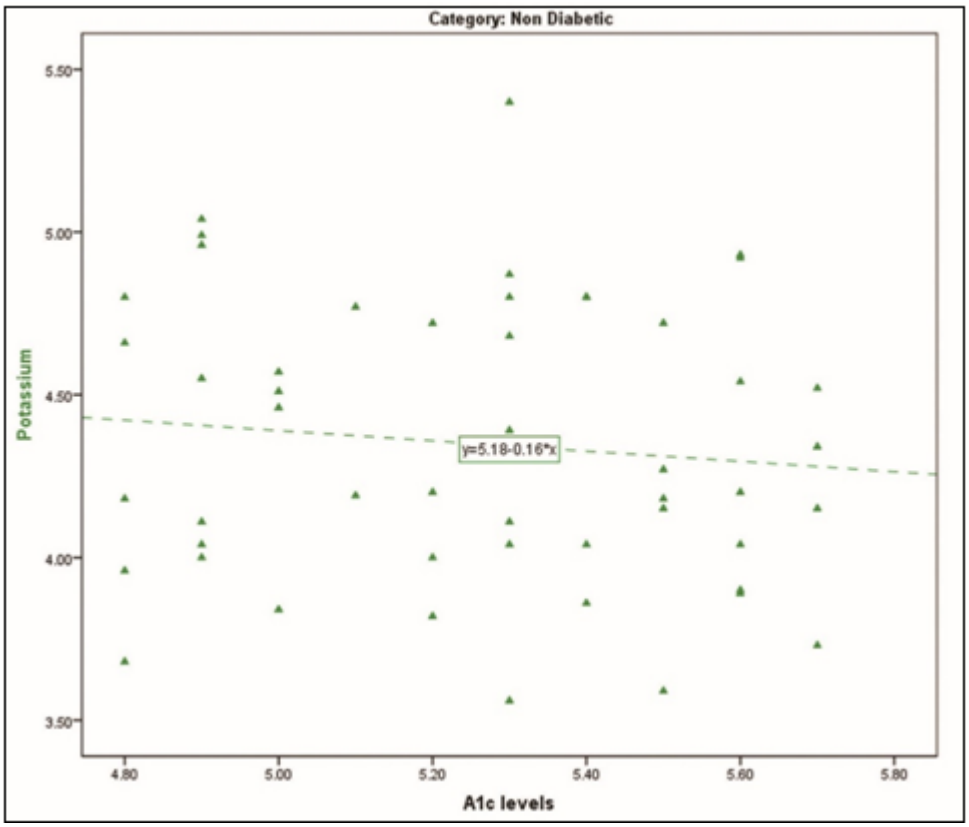

Graph 3: Non-Diabetic – senile cataract

4. Discussion

India, known as the diabetic capital of the world, contributes nearly 17% to the global diabetic population, with over 101 million diabetics nationwide.[7]Our study's results align with previous research correlating electrolyte levels with cataract formation.[8,9]

Lens has a high content of potassium (K+) and low content of sodium (Na+).[10] These two cations are in balance with each other due to sodium potassium ATPase (Na+/K+ ATPase) pump and lens capsular permeability. With aging there is an increase in membrane permeability of the lens cells due to reduced activity of Na+/K+ ATPase pump, which leads to an increase in internal Na+.[11] Variation of electrolytes in the serum in turn alters the cation concentration of aqueous humors, which ultimately affects lens metabolism leading to cataract formation.

Dysnatremias may result because of various mechanisms operating in diabetes mellitus. Both hypo and hypernatremia are reported in diabetics. Normal Serum sodium is a result of equilibrium between dilutional hyponatremia and hypernatremia due to glycosuria induced osmotic diuresis. Disturbance of equilibrium of water and electrolytes disturbs colloid system within lens fibers leading to opacification of the lens. There is a greater incidence of hyperkalemia in diabetics due to the shift of potassium to the extracellular compartment, whereas hypokalemia in diabetics is attributed to insulin administration which causes redistribution of potassium to the intracellular compartment.[12]

Previous studies have highlighted a significant difference in serum sodium levels between those suffering from age-related cataracts and those without cataracts. Diets high in sodium could potentially contribute to the formation of senile cataracts. In Madhya Pradesh, food items made of gram flour, which have high salt and oil content are widely used as side dishes during meals, may be considered a contributing factor. The use of low-sodium salts to manage hypertension could have led to the weak correlation observed between potassium levels and senile cataracts in the diabetic population.[13]

Moreover, the findings considering diabetes were relatively new as persons with good and fair glycemic control exhibited an association with serum sodium electrolyte levels and senile cataracts, whereas people with Fair glycemic control also, indicated a moderate association with serum potassium levels and senile cataracts.

Recommended drugs to delay cataracts, often work on the principle which helps to prevent cataracts where Calcium chloride reverses calcium depletion (due to aging) by increasing the calcium stores in the eyes, potassium iodide and sodium chloride work by maintaining osmotic pressure and lens permeability by balancing intracellular potassium and extracellular sodium ions in the lens membrane which results in the electrolyte balance thus maintaining lens permeability and preventing the occurrence of cataract due to electrolyte imbalance.[14]

A prospective cohort study could potentially elucidate the causal effect of serum electrolytes on cataracts. Given that our study did not include a population without cataracts, we cannot definitively establish the causative nature of altered electrolytes in cataractogenesis. Future research endeavors could aim to uncover a causative link between these factors.

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5. Limitations of the Study

The study was observational and of brief duration, hence a causal relationship could not be established. The subjects were not randomized. The blood biochemistry did not encompass all components of the serum electrolyte study, such as Chloride, Calcium, Magnesium, Bicarbonate, Phosphate, and was confined to Sodium and Potassium. The study did not consider the dietary profile of the patients, which could have influenced the development.[15–17]

The study was unable to sample individuals with senile cataracts from various socio-economic statuses and was restricted to beneficiaries of the ESI scheme, a social security initiative by the Ministry of Labor, Government of India.

6. Conclusion

Sodium (Na++) and Potassium (K+), along with poor glycemic control, could serve as indicators for senile cataracts in diabetics, as opposed to non- diabetics. By moderating sodium and potassium intake through dietary means, the onset of cataractogenesis in individuals with diabetes could potentially be delayed more than in those without diabetes. This proactive approach could aid in preventing disabilities and other health risks, thereby enhancing the overall quality of life.

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Author Profile

Dr. Priyanka, an accomplished ophthalmologist, completed her M.B.B.S from DAVV University, India in 2013, and went on to pursue M.S Ophthalmology from Malwanchal University, India

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in 2018. During her tenure as an Assistant Professor at IMCHRC, Indore, she developed a keen interest in anterior segment surgeries. This led her to complete a fellowship in Comprehensive Ophthalmology from Shivanand Mission Eye Hospital, Gujarat, India. With a decade of work experience under her belt and thousands of successful surgeries and procedures to her credit, she has been serving the public as a Consultant Ophthalmologist at ESIC hospital, Indore since 2021.

Dr. D Rajakannan, an esteemed alumnus of Annamalai University with an MBBS degree and a specialization in Ophthalmology from Aravind Hospital, Madurai, has dedicated over 25 years to clinical practice in both private and public sector hospitals. Throughout his illustrious career, he has served millions of patients and has been recognized with numerous national and state awards for his innovative contributions, including stem cell grafting and crutch glasses. Currently, he leads the Ophthalmology Department at ESIC, MH & ODC, Indore guiding his subordinates on the path to success and continuing to make significant strides in his field.

Dr. Saurabh, a distinguished alumnus of "Jamia Hamdard", one of India's top 20 universities, completed his graduation in Occupational Therapy with a focus on Ergonomics in 2011. He further pursued Post Graduation in Occupational Therapy (Neurological Disorders), with his research centered on Tele-rehabilitation. This pioneering study on Tele-rehabilitation in the country was submitted to "Guru Gobind Singh Indraprastha University", Delhi, and served as the foundation for setting up a tele-rehab unit at a leading institute in New Delhi. With over 15 years of experience and a passion for knowledge sharing, he currently heads the Occupational Therapy Department at the ESIC MH & ODC, Indore, since November 2017. His recent work unveiled the current status of occupational therapy practices in India.

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