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Original Research Article

Prevention and Early Detection of Cataract: The Role of UV Protection, Healthy Diet, and Routine Eye Screening

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Abstract:

Background: Cataract is one of the leading causes of avoidable blindness worldwide. Preventive strategies such as ultraviolet (UV) protection, dietary modification, and regular eye screening may delay onset and improve early detection.

Objective: To assess the effectiveness of preventive measures and early detection strategies for cataract in a hospital-based population.

Methods: A prospective study was conducted over one year (September 2024- August 2025) at IMS & SUM Hospital II, Phulnakhara. A total of 200 adults aged 40 years and above were enrolled. Participants were counseled regarding UV protective eyewear, a diet rich in antioxidants, and advised routine eye examinations every six months. Baseline and follow-up ophthalmic evaluations were performed, including visual acuity, slit-lamp examination, and fundus evaluation. Data on compliance and new cataract diagnosis were recorded.

Results: Of the 200 participants, 120 (60%) regularly used UV-protective sunglasses, 140 (70%) reported improved dietary intake of fruits and leafy vegetables, and 160 (80%) attended routine screening visits. During the one-year period, 18 participants (9%) developed early lens opacities suggestive of cataract. Among these, 14 (77.8%) were detected at an early stage due to scheduled screening. Compliance with UV protection and diet showed a lower incidence of cataract compared to non-compliant groups ($p<0.05$).

Conclusion: UV protection, healthy diet, and routine screening are effective measures in reducing the incidence and enabling early detection of cataract. Incorporating these strategies into community awareness programs may significantly reduce cataract-related visual impairment.

Introduction

Cataract is the leading cause of reversible blindness worldwide and remains a major public health issue in India. Global estimates consistently highlight cataract as a dominant contributor to visual impairment, while national data from India underscore its substantial burden on blindness prevalence and incidence [1-3]. Although modern cataract surgery effectively restores vision, the high case load and resource constraints in many regions emphasize the value of preventive strategies and early diagnosis to reduce avoidable visual loss and health-system strain [4].

Among modifiable risk factors, ultraviolet (UV) radiation and suboptimal nutrition are especially important. Prolonged exposure to UV-B damages lens proteins and accelerates lens opacification, providing a biologically plausible and epidemiologically supported pathway to cataract formation [5]. Practical measures such as wearing UV-blocking sunglasses and wide-brimmed hats reduce ocular UV exposure and are recommended in high-insolation settings. Nutrition likewise influences cataract risk: antioxidant vitamins (C and E), carotenoids (lutein, zeaxanthin), and other phytochemicals in fruits and leafy vegetables help counter lens oxidative stress [6]. Cohort and population studies associate higher intake of these nutrients and healthier dietary patterns with lower risk and slower progression of lens opacities [6–8].

Regular ophthalmic screening in adults—particularly from the fourth decade onward—facilitates early identification of lens changes, reinforces preventive behaviors, and enables timely planning for surgery when indicated. As a core Vision 2020 priority, systematic case finding and integration of cataract detection into routine eye care can reduce the proportion of late presenters and the burden of advanced disease. Against this

background, the present prospective study at IMS & SUM Hospital II, Phulnakhara, evaluates the impact of UV protection, dietary modification, and routine eye screening on reducing incidence and enabling early detection of cataract.

Materials and Methods

- **Study design:** Prospective observational study.
- **Study setting:** IMS & SUM Hospital II, Phulnakhara.
- **Study duration:** 1 year (September 2024–August 2025).
- **Sample size:** 200 adults aged ≥40 years, without pre-existing cataract at baseline.
- **Inclusion criteria:** Patients attending outpatient clinics, willing to participate, and without prior ocular surgery.
- **Exclusion criteria:** Patients with diabetes mellitus, steroid use, or other ocular comorbidities known to predispose to cataract.
- **Interventions:**
  - Counseling on UV-protective measures (sunglasses/hat use).
  - Dietary advice focusing on antioxidant-rich foods.
  - Regular eye examinations every six months.
- **Outcome measures:** Incidence of new cataract cases, stage of detection, and correlation with compliance to preventive measures.
- **Statistical analysis:** Data analyzed using SPSS v25. Chi-square test used for association; $p<0.05$ considered significant.

Results

A total of 200 participants aged 40 years and above were enrolled in the study. The mean age was 52.4 ± 7.8 years. Males accounted for 110 (55%) of the sample, while females were 90 (45%). At baseline, none of the participants had clinically detectable cataract.

Table 1: Baseline Characteristics of Participants (N = 200)

Variable	Value
Mean age	52.4 ± 7.8 years
Gender (M/F)	110 (55%) / 90 (45%)
Occupation	Outdoor workers – 120 (60%) Indoor workers – 80 (40%)
No. with family history of cataract	42 (21%)

Table 2: Compliance with Preventive Measures

Preventive Measure	Compliant n (%)	Non-Compliant n (%)
Regular use of UV protection (sunglasses/hat)	120 (60%)	80 (40%)
Improved dietary intake (fruits, leafy vegetables)	140 (70%)	60 (30%)
Routine eye screening attendance	160 (80%)	40 (20%)

Table 3: Incidence and Stage of Cataract During 1-Year Follow-Up

Outcome	n (%)
Total new cataract cases	18 (9%)
Early-stage cataract	14 (77.8% of cases)
Advanced-stage cataract	4 (22.2% of cases)

Table 4: Association of Preventive Measures with Cataract Incidence

Preventive Measure	Cataract Incidence	p-value
UV protection (n=120)	5 (4.2%)	<0.05
No UV protection (n=80)	13 (16.2%)	
Improved diet (n=140)	6 (4.3%)	<0.05
No dietary change (n=60)	12 (20.0%)	
Attended screening (n=160)	10 (6.3%)	<0.05
Missed screening (n=40)	8 (20.0%)	

Discussion

Cataract remains the most common cause of blindness worldwide and is a major contributor to visual impairment in India. Although modern cataract surgery can effectively restore vision, many individuals continue to present late for intervention or face socioeconomic and logistical barriers that delay treatment. In such circumstances, preventive strategies and early detection measures become vital to reduce the burden of avoidable blindness. The present prospective study assessed the impact of ultraviolet (UV) protection, dietary modification, and routine eye screening on the incidence and early detection of cataract. The findings indicate that all

three interventions play a significant role in lowering disease risk and facilitating timely management.

Over the one-year follow-up, 9% of participants developed lens opacities; however, the majority were detected at an early stage due to regular ophthalmic evaluations. Early detection is crucial, as it prevents progression to advanced cataract, which is often associated with severe vision loss and functional limitations [9]. Routine screening is cost-effective, easily implementable, and can be integrated into outpatient or community-level eye care programs. Regular eye examinations for adults over 40 years of age are especially important in semi-urban and rural populations where awareness and access to specialized care remain limited [10].

Among the established environmental risk factors, ultraviolet radiation is a well-recognized cause of lens protein damage leading to cataract formation [1–4]. Chronic exposure to UV-B rays induces oxidative modification and aggregation of lens proteins, accelerating opacification [2,3]. In this study, participants who regularly used UV-protective eyewear demonstrated a markedly lower incidence of cataract (4.2%) compared to those who did not (16.2%), consistent with previous epidemiologic findings [11]. Despite the proven benefit, compliance with UV protection was only 60%, reflecting the challenges of cost, awareness, and behavioral change. Outdoor workers, who are most exposed to sunlight, remain particularly vulnerable. Public health interventions that promote affordable UV-protective eyewear and community awareness campaigns could substantially enhance adoption of this simple but effective preventive measure [12].

Nutritional status also played a significant role in cataract prevention. Participants who improved their intake of antioxidant-rich foods—especially fruits and green leafy vegetables—had a cataract incidence of just 4.3%, compared with 20% among those who made no dietary changes. Antioxidants such as vitamins C and E, carotenoids (lutein and zeaxanthin), and polyphenols protect the crystalline lens from oxidative stress and lipid peroxidation [5,6,9,11]. Several studies, including the Age-Related Eye Disease Study (AREDS), have demonstrated that higher dietary or supplemental intake of these nutrients is associated with a lower risk and slower progression of lens opacities [7–10]. These findings are in line with prior epidemiologic reviews emphasizing the role of nutrition in lens health [13,14]. However, challenges persist in maintaining consistent dietary improvements due to the variable affordability and availability of fresh produce, particularly in semi-urban and rural populations. Strengthening community nutrition and health promotion programs could improve long-term adherence to protective dietary habits [15,16].

Routine ophthalmic screening emerged as the strongest predictor of early cataract detection in this study. Participants who attended regular check-ups had a lower incidence (6.3%) compared with those who missed their appointments (20%), and most cases were diagnosed at an early stage. Similar evidence from large-scale blindness surveys supports the effectiveness of periodic eye examinations in reducing the proportion of advanced cataract cases [16-18]. Screening not only aids in timely identification but also provides a valuable opportunity for continuous patient education about preventive measures and the importance of lifestyle modification [17,19]. Integrating screening into general health check-ups or community health camps could further extend its reach and impact in resource-limited settings [20].

The present study has some limitations. The relatively short follow-up period may not fully capture the long-term preventive effects of these interventions. Compliance with UV protection and dietary modification was self-reported, which introduces the possibility of reporting bias. Additionally, as a hospital-based study, the results may not reflect population-level patterns across different socioeconomic strata. Nevertheless, the findings align with prior studies demonstrating the benefits of UV protection, antioxidant nutrition, and regular screening as low-cost, feasible strategies for delaying or detecting cataract onset.

Incorporating these evidence-based preventive approaches into national blindness-control and Vision 2020 initiatives could help reduce the cataract burden in India. Targeted public health programs promoting UV safety, balanced nutrition, and regular ophthalmic screening can significantly lower the prevalence of cataract-related visual impairment and support the goal of universal eye health.

Conclusion

Cataract prevention and early detection can be effectively achieved through UV protection, antioxidant-rich diets, and regular ophthalmic screening. The study demonstrates that simple lifestyle modifications, when adopted consistently, significantly reduce the incidence and aid early diagnosis of cataract. Incorporating these strategies into routine health education and outreach programs has the potential to lower cataract-related blindness in India.study.

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