

Cataract in Professionals Exposed to Solar Radiation: A Cross Sectional Study

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ABSTRACT

Purpose: To find out frequency of cataract in seaside workers and possible factors associated to its development.

Study Design: Cross sectional observational.

Place and Duration of Study: Tyrrhenian coast of Tuscany (Italy), between Rosignano Marittimo and Cecina municipalities in July 2021.

Methods: Ninety-eight seaside workers were selected through convenience sampling technique. All the working subjects selected for this study had a bilateral natural vision equal to or greater than 6/10 in the anamnestic data collection, declared they had not eye diseases in the past and rarely used protective glasses during their work.

Results: The mean age of 98 outdoor workers is 40. Patients with the cataract are older than people without cataract (median 41 vs 38) ($p < 0.001$) and have a lower visual acuity (0.6 vs 0.7) ($p < 0.001$); stratifying by job, refraction state and Intra Ocular Pressure (IOP), there aren't significant association with cataract. The multivariate analysis confirms that age and visual acuity are associated with the development of the cataract (OR 1.99 and 0.01, respectively).

Conclusion: Although senile cataract is an age related disease but Visually significant cataract is seen in persons working outdoors for longer hours.

Key Words: Cataract, Solar Radiation, Italy, Ultraviolet radiation.

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INTRODUCTION

Cataract is a clouding of the lens of the eye which precludes clear vision. Cataract is the major cause of blindness: in fact WHO estimated that, in people over 50, 94 million became visually impaired due to cataracts.¹

According to the etiology, cataract can be classified as senile, pediatric and secondary cataract. Age-related cataract is the most common type, with onset between 45 years and 50 years. Senile cataract occurs as a result of direct oxidative stress.² In epidemiological studies, the most commonly used classification is based on the localization of lens opacities within the lens, and it can be divided into three types: nuclear, cortical, and posterior sub-capsular cataracts. Nuclear cataract is the most frequent form, followed by cortical cataract and posterior sub-capsular cataract.³ Use of certain medicines and Diabetes Mellitus are often associated with this disease. However, the main determinant is the exposure to long-term ultraviolet (UV) radiation,

especially in outdoor workers. Scientific data support the role of solar radiation in inducing nuclear and posterior sub-capsular cataract.⁴ Outdoor workers are a large occupational group, including farmers, construction workers and others: only in Europe, the estimated number is about 14.5 million.⁵

Outdoor workers have a relevant exposure to solar radiation which exceeded the limit of 30 J/m² (effective radiant exposure is referred to a daily exposure of 8 h).⁶

The aim of this study was to find out frequency of cataract in outdoor workers, and also to find out about the specific subtypes of cataract related with solar radiation. This will help in evaluating the occupational risk related to long-term exposure to solar radiation.

METHODS

A cross-sectional study was conducted in July 2021 involving seaside workers. The sample included 98 persons from the stretch of the Tyrrhenian coast of Tuscany (Italy), between Rosignano Marittimo (LI) and Cecina (LI) municipalities. They were selected through convenient sampling and included workers under the age of 50, who lived in a marine environment. The study population was categorized according to age, job (coastguard, fishermen, lifeguards and port maintenance worker. The participants declared that they had no ocular disease in the past, and they rarely used protective glasses during their work. After history, complete ocular examination was performed which included visual acuity, retinoscopy, refraction (astigmatism, emmetropia, hypermetropia, myopia), anterior segment examination and fundus examination with Direct Ophthalmoscope. The spectacles of the participants were analyzed using Lensmeter. Particular attention was given to the degree of lens opacity. Opacity was described in three degrees; incipient cataract, intumescent cataract and mature cataract.

The statistical analysis was carried out using frequency and contingency tables. Differences between groups were tested using the chi-square test and the Mann-Whitney test for categorical and continuous variables, respectively. Finally, a logistic regression analysis was performed for assessing the factors associated to the occurrence of cataract. The results are presented as Odds Ratio (OR) and 95% Confidence Interval (95% CI). The results are presented showing the full model with all the variables

and a stepwise approach (backward elimination procedure).

The statistical analysis was done using the software IBM SPSS Statistics version 26 (IBM Corp. Somers NY, USA). The level of significance was set at $p < 0.05$.

RESULTS

The mean age of 98 outdoor workers was 40 (36 – 47). Other characteristics are described in Table 1.

Table 1: Characteristics of the sample population.

| Variable | |
|-------------------------|------------------|
| AGE mean (range) | 40 (36 – 47) |
| Job Description | N (%) |
| Coastguard | 20 (20.4) |
| Fishermen | 25 (25.5) |
| Lifeguards | 24 (24.5) |
| Port maintenance worker | 29 (29.6) |
| Refractive State | N (%) |
| Astigmatic | 12 (12.2) |
| Emmetropic | 74 (75.5) |
| Hypermetropic | 12 (12.2) |
| IOP mean (range) | 15 (14 – 20) |
| Visual Acuity | 0.75 (0.6 – 0.9) |
| Cataract | N (%) |
| No | 40 (40.8) |
| Incipient cataract | 55 (56.1) |
| Intumescent | 3 (3.1) |

Table 2: Univariate analysis on the association between factors and cataract.

| Variable | Cataract No | Cataract Yes | P |
|-------------------------|-----------------|-----------------|---------|
| Age | 38 (36-40) | 41 (36-47) | < 0.001 |
| Job Description | | | |
| Coastguard | N (%) | N (%) | |
| Fishermen | 7 (35) | 13 (65) | 0.495 |
| Lifeguards | 11 (37.5) | 18 (62.5) | |
| Port maintenance worker | 9 (36) | 16 (64) | |
| Refractive State | N (%) | N (%) | |
| Astigmatic | 4 (33.3) | 8 (66.7) | 0.390 |
| Emmetropic | 29 (39.2) | 45 (60.8) | |
| Hypermetropic | 7 (58.3) | 5 (41.7) | |
| IOP in mm Hg | 15 (14 - 18) | 15 (14 - 20) | 0.753 |
| Visual Acuity | 0.7 (0.6 – 0.9) | 0.6 (0.6 – 0.9) | < 0.001 |

In Table 2, the associations of different factors with cataract are described. Patients with the cataract are older than people without cataract (median 41 vs 38) ($p < 0.001$), and have a lower visual acuity (0.6 vs

Table 3: Multivariate analysis on the association between and cataract and other factors.

| Variable | OR (95% CI) Full model | OR (95% CI) Stepwise model |
|-----------------------------------|---------------------------|----------------------------|
| Age | 2.02 (1.44 – 2.84) | 1.99 (1.44 – 2.76) |
| <i>Job Description</i> | | |
| Coastguard | 2.69 (0.51 – 14.17) | |
| Port maintenance worker fisherman | 0.78 (0.16 – 3.75) | |
| Lifeguard (reference) | 0.75 (0.15 – 3.70) | |
| | 1 | |
| <i>IOP</i> | 1.12 (0.73 – 1.71) | |
| <i>Visual Acuity</i> | 0.01 (0.00 – 0.03) | 0.01 (0.00 – 0.08) |

0.7) ($p < 0.001$). Stratifying by job, refractive state and Intra Ocular Pressure (IOP), there was no significant association of these factors with cataract.

Table 3 shows a multivariate analysis showing association of age and visual acuity with cataract.

DISCUSSION

The results of this study showed that cataract had an association with age and decreased visual activity. The study in question was conducted on a sample with homogeneous visual conditions, age, profession, and exposure to ultraviolet light. Previous studies have explored the distribution of cataract types in the general population.^{7,8,9} Even with so much advancement in cataract surgery, causative factors and techniques to delay or prevent the development of cataract is a major challenge for the 21st century.

Cataract is a part of aging process and environmental factors also play an important role in it.¹⁰ Among the environmental factors, solar radiation is considered to be associated with cortical and posterior subcapsular cataract.^{11,12}

However, there are other studies which relate nuclear cataract with solar radiation exposure.¹³ In this particular study, incipient cataract was found to be associated with sunlight exposure at Tyrrhenian coast of Tuscany (Italy), between Rosignano Marittimo and Cecina municipalities. Our population was younger than 50 years of age.

Yu et al found that the OR was 2.61 for Chinese agricultural workers with a UV annual exposure higher than 2700 joules per square-metre, based on a semi-quantitative evaluation.⁷ In our study, there was no quantification of the UV exposure.

Our study underlines the association between age and visual acuity with cataract. A range of effective strategies are available to address the needs associated

with eye conditions and vision impairment across the life course. These include health promotion, prevention, treatment and rehabilitation strategies, some of which are among the most feasible and cost-effective of all health care interventions. It is important to understand the factors, which contribute to the pathogenesis of early cataracts and this study has highlighted UV light as a contributory factor. Animal studies have shown that UV exposure results in changes in lens epithelial cells and not in the lens fibers.¹⁴ The resultant changes include oxidative stress to the lens and the inflammatory reaction which are responsible for opacification of the lens.¹⁵

Studies on the use of protective lenses to prevent cataract formation indicate that cataract burden can be reduced to more than 5% by the use of protective lenses.^{16,17} Other protective mechanisms include hats, goggles and special caps which can lead to less exposure to solar radiation.^{18,19} Not only the UV light causes damage to the crystalline lens but it also damages retina for which UV protective intraocular lenses are implanted after cataract surgery.²⁰

The limitations of this study is the cross sectional design. Future longitudinal studies are warranted to clarify the direction of causality. Nevertheless, cataract highlights an important health priority which needs intervention.

CONCLUSION

Although senile cataract is an age related disease but visually significant cataract is seen in persons working outdoors for longer hours.

Conflict of Interest: Authors declared no conflict of interest.

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Author's Designation and Contribution

Mauro Salducci: Professor; *Concepts Design, Literature Search, Data Acquisition, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

Maria Vittoria Manai; Resident; *Data Analysis.*

Giuseppe LA Torre: Professor; *Statistical Analysis.*

