Geographical ophthalmology

Casteldaccia eye study: prevalence of cataract in the adult and elderly population of a Mediterranean town

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Abstract

Prevalence of cataract was studied in a population based survey performed in adults aged 40 years or more living in Casteldaccia, a small Sicilian town. Lens opacities of moderate or severe grade (type II or worse, according to the Lens Opacity Classification System II) were found at the following rates: nuclear opalescence in 18.5%, cortical cataract in 12.9%, posterior subcapsular cataract in 10.8%. All these types of cataract were much more frequent in the elderly population and were about 1.5 times more common in women than in men. Late cataract was found in about 1/3 of subjects aged 60 to 69 years, in 2/3 of subjects aged 70 or more, but rarely under 60 years of age. However, early cataract was rather common among younger subjects. Cataracts causing a reduction of visual acuity under 0.7 in the worst eye were found in 4%, 8.7% and 21.5% respectively in the three age groups ranging from 40 to 49, 50 to 59 and 60 to 69 years and in 54.4% of subjects 70 years old or over.

Introduction

The prevalence of cataract has only been reported in a few geographic areas in the world like United States [1–4] or Asiatic countries [5–7] and an association with UV exposure has been postulated. The assessment of cataract prevalence in other areas around the world will help determine the independent and relative effects of potential risk factors such as environment, heredity, comorbidity, and diet.

The reported prevalence rates show a certain variability either because of objective differences among the studied populations or differences as to the definition of cataract. Thus, these studies are not always easily comparable. Besides the discordant definitions of cataract, the evaluation and recording of the various lens changes are also different; moreover, in some cases prevalence rates do not include the various types of lens opacity (nuclear, cortical, posterior subcapsular) and no adjustement has been made as to the age of the studied populations. From the results of these surveys it seems that cataract is more frequent in Asian individuals, probably because of racial and environ-mental factors. Very few data are available on cataract prevalence in the Mediterranean basin [8].

The Casteldaccia Eye Study is a prevalence study of ocular diseases performed on a population sample of a Sicilian town. For the evaluation of the nuclear, cortical and subcapsular opacities a standard method has been used. Moreover, cataracts have been classified following either a morphological or a functional criterion. In this paper we report the cataract prevalence rates of this population, stratified according to sex and age.

Materials and methods

The Electoral Register of Casteldaccia shows that this town includes 3,176 inhabitants whose age ranges from 40 to 99 years; all people are white. We performed a stratification of these people according to sex and age. Concerning age, 4 groups were formed, made up of subjects between 40 and 49, 50 and 59, 60 and 69, and of 70 or over years of age. A stratified random sample was made using random numbers to enroll half

of the subjects of the 8 groups in the Casteldaccia Eye Study.

All these subjects were sent an invitation for an ophthalmologic examination through a letter which explained the purpose of the study; a further invitation was sent to the non-responders.

The ophthalmologic examination was performed in Casteldaccia by a group of 10 ophthalmologists and more senior ophthalmic residents after a one-month training period to reduce interobserver differences in the evaluation of eye parameters. After registration of the subjects, an epidemiologic data form was filled in. The history was taken to determine exposure to suspected risk factors for ocular diseases. These included behavioral and environmental variables, use of drugs, systemic physiologic and pathologic conditions. Among the others, the following factors were assessed: job, hours of daily sunlight exposure, smoking, alcohol intake, use of corticosteroids, NSAIDs, tranquillizers, oral contraceptives; pregnancies, menopause, systemic hypertension, diabetes, allergy.

The ophthalmologic examination included the following: measurement of visual acuity with Snellen letters; measurement of refractive error with refractometer; examination of central visual field by Amsler grid; inspection of external eye; examination of conjunctiva, cornea, anterior chamber and iris with slit lamp; staining of precorneal tear film with fluorescein; measurement of lacrimal meniscus and breakup time; instillation of topical anaesthetic; applanation tonometry with Goldmann tonometer; pupillary dilation; lens slit-lamp examination; ophthalmoscopy.

Further details about the conduct of the survey are reported elsewhere [9, 10].

Lens examination

The lens examination was performed with maximum mydriasis, obtained by instilling tropicamide 0.5% and phenylephrine 10% drops. If the anterior chamber was shallow (grade 1 and 2 of Van Herick et al. classification [11]) the patient was made aware of the risk of developing angle-closure glaucoma, precipitated by topical mydriatics, and then the examination was completed only with the patient's consent.

Slit lamp examination of the lens was performed and lens opacities were classified according to the Lens Opacity Classification System II or LOCS II [12]. In particular, the lens nucleus was observed using an optic section with the slit beam angled at 45 degrees, while the cortical and posterior subcapsular zones of the lens were evaluated using retroillumination. Four lens parameters were evaluated: nuclear opalescence, nuclear color, cortical opacities and posterior subcapsular opacities. The extent of the changes occurring in the above-mentioned 4 lens parameters was compared with that of some standard photographs placed near the examiner; then, a grading of the 4 lens parameters was performed. Nuclear opalescence was graded into 5 classes, nuclear color into 3 classes, cortical opacities into 7 classes and posterior subcapsular opacities into 3 classes.

Before the survey, the examiners were trained in the procedures of lens evaluation. A high interobserver agreement was found when LOCS II was used for grading cataracts at slit lamp (k ranged from 0.79 to 0.95 for the various lens abnormalities); this reproducibility of assessments is similar to what has been observed in other studies [13, 14]. The presence of aphakia or pseudophakia was noted.

The presence of cataract was evaluated following either a morphological or a functional criterion. On a merely morphological basis, a lens with any change (nuclear, cortical, posterior subcapsular) showing a LOCS grade lower than II was defined as an early cataract. On the other hand, a lens with at least one of the three types of lens opacities equal to or higher than grade II was defined as a late cataract.

For the functional criterion, a subject with any lens opacity responsible for a visual acuity lower than 0.7 in the most seriously affected eye was considered as having a clinically significant cataract.

Prevalence estimates with 95% confidence limits were calculated for the various types of lens opacities. The overall difference in the prevalence of lens opacities between the two sexes was evaluated with a chi-square test; the sex-difference according to age was evaluated using the Mantel-Haenszel test.

Rate of participation

Table 1 provides the number of the subjects aged 40 years old or more resident in Casteldaccia divided into age-groups, the number of the subjects enrolled for the study, the number of the people actually examined and the response rate to the study. Out of 1,588 subjects enrolled for the study, 1,068 could be examined; thus the response rate was 67.3%, ranging from 50.8% to 84%, depending on the groups.

In two groups the rate of participation was low, namely among younger males and older women. Males of 40–49 years had difficulties participating because of
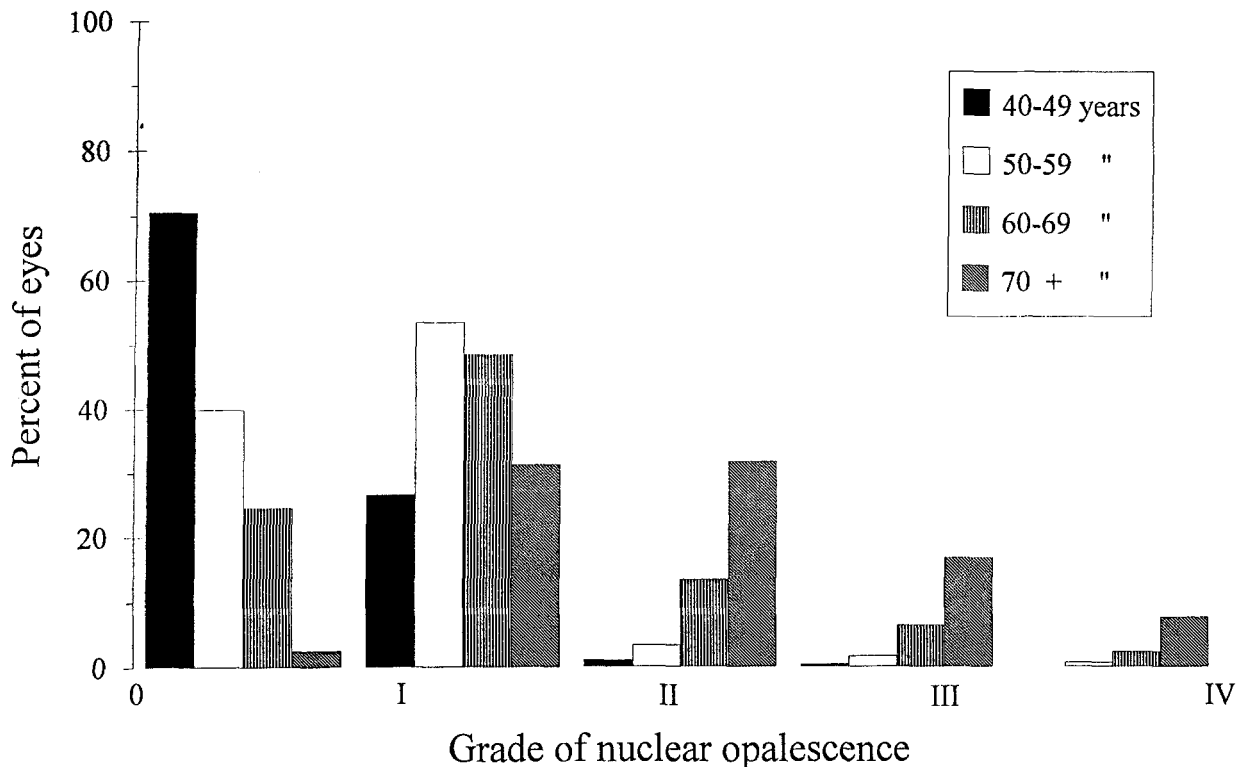
Fig. 1. Distribution of nuclear opalescence by age in the right eyes. 0 = nuclear opalescence of grade N0, I = nuclear opalescence of grade NI, II = nuclear opalescence of grade NII, III = nuclear opalescence of grade NIII, IV = nuclear opalescence of grade IV.

sexes were greater considering only the highest grade of nuclear opalescence (NIV), that was found in 1.6% (c.l. = 0.5–2.6) of males and in 3% (c.l. = 1.7–4.3) of females of the third age-group and in 3.8% (c.l. = 1.9–5.7) of males and in 12.2% (c.l. = 8.8–15.7) of females of the fourth age-group.

The nucleus color was pale yellow (type 0) in most of the subjects under 60 years of age, while in people of 60 years of age or over nuclei dark yellow in color (type 1) were more frequently found; more than 1/3 of the subjects belonging to the oldest age-group had nuclei which were orange in color (type 2) (Fig. 2).

Mild cortical opacities were relatively frequent at all ages, while the most serious ones were nearly exclusively observed in the oldest age-group (Fig. 3). The overall prevalence of moderate or high grade cortical opacity (equalling or exceeding CII) in the right eyes was 12.9% (c.l. = 11.9–14); in the 4 age-groups it was 0.9% (c.l. = 0–1.8), 3.1% (c.l. = 1.6–4.6), 14% (c.l. = 10.9–17) and 30.5% (c.l. = 26–35) in males and 0.6% (c.l. = 0–1.2), 7.8% (c.l. = 5.7–9.9), 19.1% (c.l. = 16–22.1) and 41.2% (c.l. = 36–46.4) in females (chi-square = 1.6, P < 0.5; odds ratio = 0.6, c.l. = 0.4–0.9).

The highest grades of cortical opacity (CIV and CV) were much more frequently observed in females.

The presence of posterior subcapsular opacities of grade II or worse was observed in 10.8% (c.l. = 9.8–11.7). They were found in 0.9% (c.l. = 0–1.8), 3.8% (c.l. = 2.1–5.5), 9.3% (c.l. = 6.8–11.9) and 30.4% (c.l. = 25.9–34.9) of males and in 0.6% (c.l. = 0–1.2), 3% (c.l. = 1.7–4.3), 13.1% (c.l. = 10.5–15.7) and 41.1% (c.l. = 35.9–46.3) of females in the 4 age-groups (chi-square = 0.1, P = n.s.; odds ratio = 0.68, c.l. = 0.44–1.06). The most serious grades (PIII and PIV) were only observed in 4.7% (c.l. = 4–5.3) (Fig. 4).

Aphakia or pseudophakia was found in 2.2% (c.l. = 1.3–3) of the right eyes and in 1.8% (c.l. = 1.4–2.2) of the left eyes of the studied population.

When cataract was defined on a morphological basis, signs of early cataract were frequently observed also in young subjects. Lens changes classifiable as early cataract were found in 40–60% of the subjects of the age-groups ranging from 40 to 69 years. A late cataract was seen in 2–4% of the eyes of the youngest group and in 10–12% of the subjects whose age was between 50 and 59 years. About 1/3 of the subjects between 60 and 69 years of age and 2/3 of those of
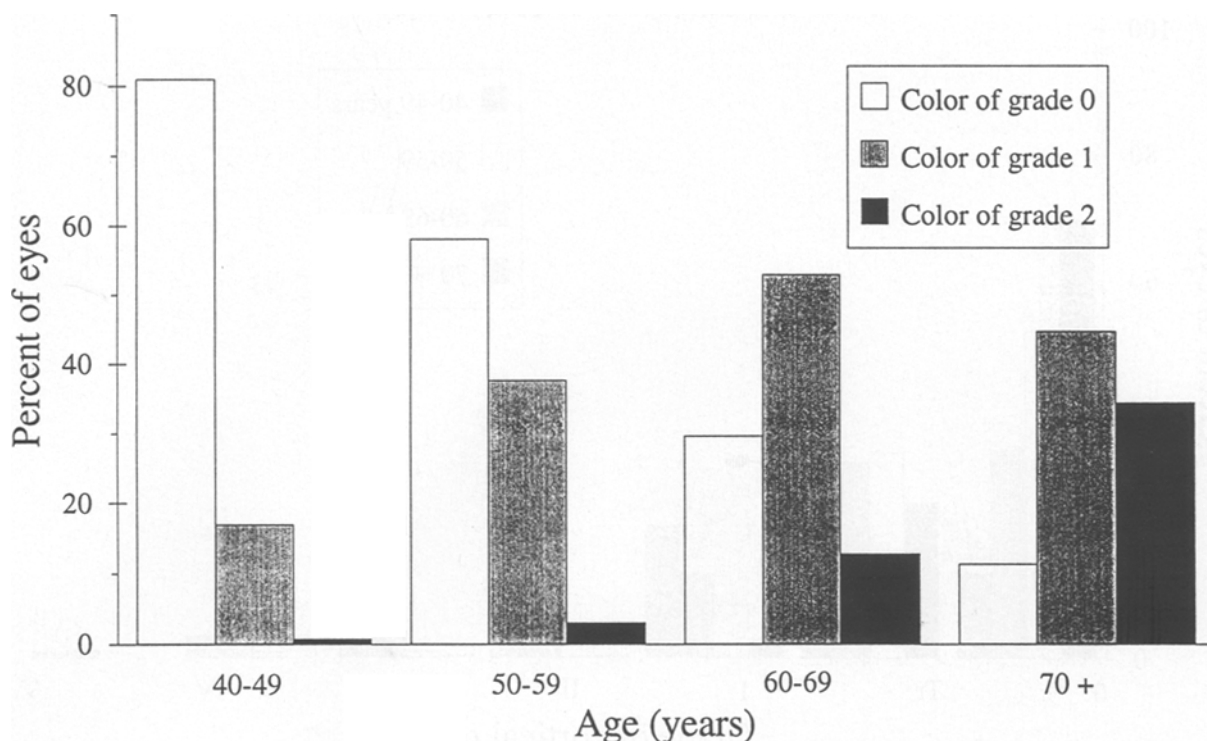
Fig. 2. Distribution of nuclear color by age in the right eyes.

70 years of age or over showed a late cataract. The right eyes were affected by cataract as frequently as the left eyes (chi-square for late cataract = 0.18, P = n.s.; odds ratio = 1.05, c.l. = 0.83–1.33). Concerning the sex, there seems to be a greater prevalence of advanced cataract among women, especially considering the two oldest age-groups (chi-square = 0.66, P < 0.5; odds ratio = 0.63, c.l. = 0.45–0.88) (Table 2).

From the functional point of view, assuming that a subject with any lens opacity responsible for a visual acuity lower than 0.7 in the most seriously affected eye has a cataract, then 19.4% (c.l. = 18.2–20.6) of the studied population is affected by cataract. In the 4 age-groups, prevalence of cataract is 4% (c.l. = 2.8–5.1), 8.7% (c.l. = 7.1–10.4), 21.5% (c.l. = 19.1–23.9) and 54.4% (c.l. = 50.8–57.9) respectively. Again, cataract has a slightly higher prevalence in women compared to men (chi-square = 0.4, P = n.s.; odds ratio = 0.7, c.l. = 0.5–0.99) (Table 3).

Discussion

The main problem concerning studies on cataract prevalence is that there is no agreement about the definition of this disease. Most often, cataract has been defined as a lens opacity reducing vision to 20/30 or worse. A cataract evaluation including a visual functional criterion may not be completely satisfying, for it is not always easy to decide if a visual loss is due to a cataract or not and, moreover, clinically advanced cataracts, especially the cortical ones, may not considerably affect visual acuity.

Recently, great emphasis has been put on the morphological evaluation of cataract performed by using classification systems based on standard photographs of the various lens opacities. Moreover, the various epidemiological studies use different classifications, so the results are difficult to compare [12, 15, 16]. In our survey we use the LOCS II [12] which is a relatively simple cataract classification system having a high reproducibility rate.

We compared our results with those obtained on populations similar to the one we studied; that is,
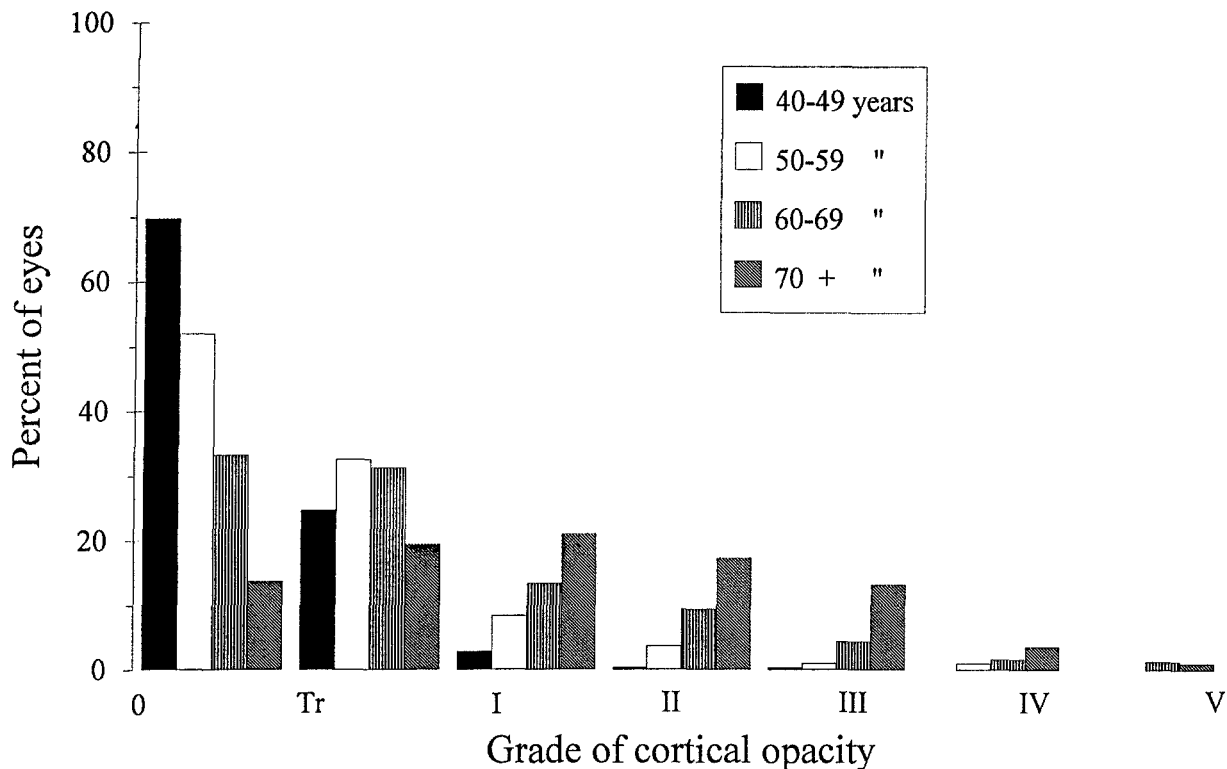
Fig. 3. Distribution of cortical cataract by age in the right eyes. 0 = cortical cataract of grade C0, Tr = cortical cataract of grade Ctr, I = cortical cataract of grade CI, II = cortical cataract of grade CII, III = cortical cataract of grade CIII, IV = cortical cataract of grade CIV, V = cortical cataract of grade CV.

Table 2. Prevalence of early cataract, late cataract and aphakia or pseudophakia in the Casteldaccia Eye Study.

	Right eyes (%)									Left eyes (%)								
	Early cataract			Late cataract			Aphakic/ pseudoph.			Early cataract			Late cataract			Aphakic/ pseudoph.		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
40–49 years	41.2	42.7	42.1	1.8	2.4	2.2	0.0	0.0	0.0	39.5	43.3	41.7	3.5	3.7	3.6	0.9	0.0	0.4
50–59 years	58.0	59.9	59.1	10.7	12.6	11.7	0.8	0.0	0.3	55.7	60.5	58.4	11.5	10.8	11.1	0.0	0.0	0.0
60–69 years	50.4	41.1	45.1	28.7	39.3	34.7	4.7	1.8	3.0	53.5	47.0	49.8	27.9	33.9	31.3	3.1	1.8	2.4
70+ years	27.6	13.3	21.0	61.9	74.4	67.7	6.7	6.7	6.7	24.8	16.7	21.0	61.9	71.1	66.2	5.7	5.6	5.6
All ages	45.3	42.6	43.8	24.6	26.8	25.8	2.9	1.5	2.2	44.5	45.2	44.9	25.1	24.6	24.8	2.3	1.4	1.8

mainly, belonging to the Caucasian race, living in a developed country of a temperate geographic zone.

Defining the cataract as a lens opacity responsible for a visual acuity lower than 0.7 (20/30), we found that the prevalence was 3.5%, 9.2%, 20.2% and 45.7% in males between 40 and 49, 50 and 59, 60 and 69, and of 70 or over years of age respectively. In the whole male population studied, prevalence of cataract was 18.8% (c.l. = 17–20.6); prevalence rates were only slightly higher for women (19.9%, c.l. = 18.2–21.5). In the other epidemiological study performed in Italy, prevalence of cataract in males was 3.4% in the group aged 41 to 60 years, 16.7% between 61 and 72 years and 45.2% for subjects of 73 or more; the overall prevalence was 17.1% [8]. These results are remarkably similar to ours; these investigators report no difference in sex-related prevalence of cataract.
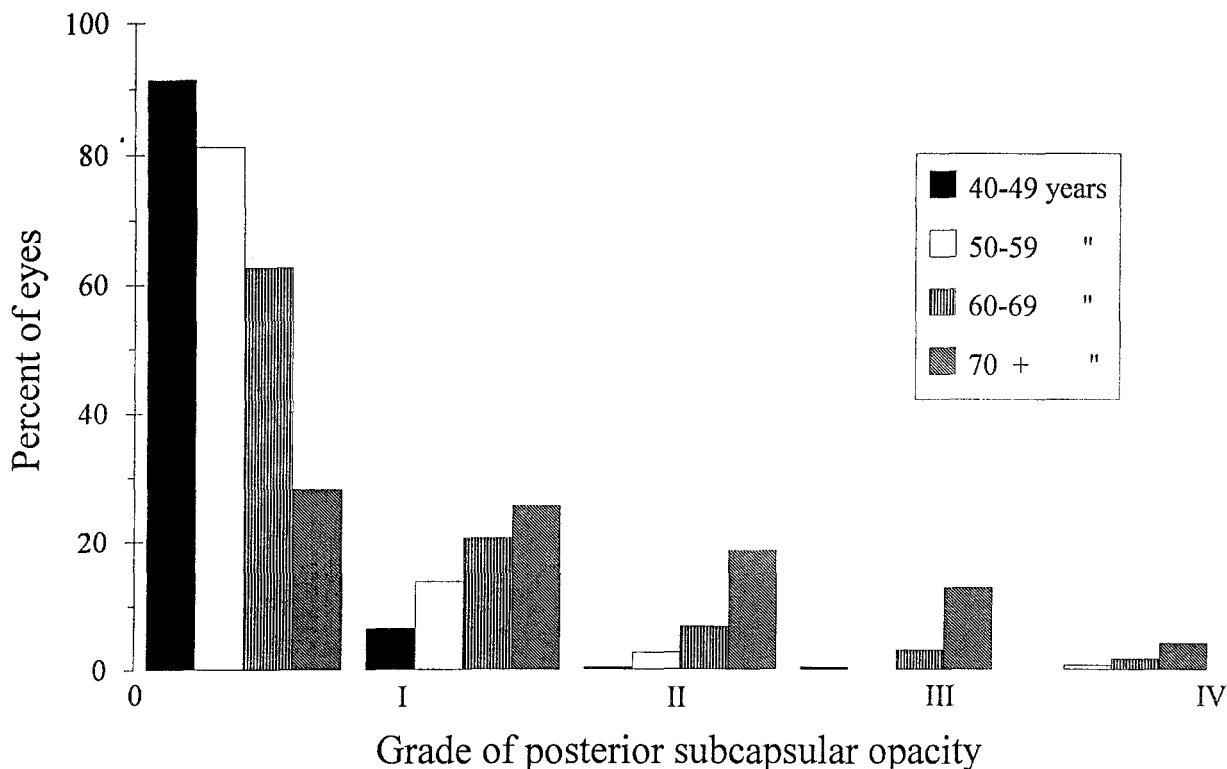
Fig. 4. Distribution of posterior subcapsular cataract (PSC) by age in the right eyes. 0 = PSC of grade P0, I = PSC of grade PI, II = PSC of grade PII, III = PSC of grade PIII, IV = PSC of grade PIV.

Table 3. Prevalence of cataract defined as lens opacity that causes visual loss greater than 0.7 in the worse eye.

	Males		Females		Total	
	Number of cases	%	Number of cases	%	Number of cases	%
40–49 years	4	3.5	7	4.3	11	4.0
50–59 years	12	9.2	14	8.4	26	8.7
60–69 years	26	20.2	38	22.6	64	21.5
70+ years	48	45.7	58	64.4	106	54.4
All ages	90	18.8	117	19.9	207	19.4

The Framingham Eye Study [2] found that cataract prevalence was 4%, 16% and 41% in males between 55 and 64, 65 and 74, and of 75 or over years of age respectively. The Beaver Dam Eye Study [4] shows very similar results: actually, except for the fact that prevalence was 0.4% in subjects ranging from 43 to 54 years of age, not included in the Framingham Eye Study, this study shows rates of 3.9% from 55 to 64 years of age, 14.3% from 65 to 74 years of age and 38.8% for 75 or over years of age. Higher prevalence rates are reported by the Chesapeake Bay Watermen Study [3] (5% in males from 50 to 64 years of age, 25% in males from 65 to 74 years of age and 59% in males of 75 or over years of age) and by the National Health and Nutrition Examination Survey [1] (3% in the 45–54 year age-group, 13% in the 55–64 year age-group and 38% in the 65–74 year age-group).

Our data are not very different from those reported by the other epidemiological surveys, especially if the prevalence of cataract in older subjects is considered.

Concerning the two groups including the youngest subjects, our rates are slightly higher than those found in other studies, except for the National Health and Nutrition Examination Survey [1], that shows that prevalence of cataract is 13% in the 55 to 64 years age-group.

However, when a functional criterion, as visual acuity, is used to define a cataract an overestimation of this disease can follow since it is possible that a concomitant retinal disease could contribute to the visual loss.

The definition of cataract on a merely morphological basis provides substantially different results when various studies are compared. The prevalence of advanced cataract reported by the Casteldaccia Eye Study in the whole population (25.8%) is remarkably higher than the one of the Beaver Dam Eye Study [4] (15.3%). Similarly, the difference in the prevalence is clear when we consider mild cataracts: actually, prevalence is 43.8% in the Casteldaccia Eye Study and 30.8% in the Beaver Dam Eye Study [4]. These differences are probably due, at least partially, to differences in the cataract classification more than to given features of the population members. In our study we define as advanced cataracts lens opacities that are of a lower grade than the ones considered as necessary to fall within this definition by the Beaver Dam Eye Study [4].

As reported by other studies, we found a slightly greater prevalence of cataract in females than in males. This difference is little in subjects from 60 to 69 years of age, but a bit higher in older subjects.

Concerning aphakia and pseudophakia, like Klein et al. [4], we did not consider these cases as late cataracts having undergone surgery, since extracapsular cataract extraction has become a technique not exclusively used for advanced or complete cataracts. Hence, aphakic eyes have been considered separately. About 2% of the eyes examined were aphakic or pseudophakic.

The most frequent lens change concerns the nucleus. Clear signs of nuclear sclerosis (nuclear opalescence of grade II, III and IV) were found in 22.3% of subjects from 60 to 69 years of age and in 56.4% of those of 70 or over years of age. Cortical cataracts are less frequent. Only 16.8% of subjects from 60 to 69 years of age and 35.3% of older subjects have cortical opacities that, altogether, affect more than 5% of the lens surface (cortical cataract of grade II, III, IV and V). A posterior subcapsular cataract affecting more than 3% of posterior capsule in its central por-

tion is found in 11.4% and 35.4% of these age-groups respectively.

The Beaver Dam Eye Study [4] showed prevalence rates of nuclear and cortical opacities similar to ours. In the group including subjects of 75 or over years of age, nuclear cataracts have been observed in 50% of cases, while cortical cataracts have been found in 42%. An important difference concerns posterior subcapsular cataracts, found in 14% of cases. Even if the definition of posterior subcapsular cataract provided by this study (an opacity affecting at least 5% of the posterior subcapsular area, regardless of its central or peripherical position) is slightly different from ours, the difference in prevalence between the two studies is meaningful; this, then, seems to show that this type of cataract is more frequent in the Sicilian population.

Also the Chesapeake Bay Watermen Eye Study [3] shows a lower prevalence of posterior subcapsular cataracts. However, this study shows that this type of cataract is found in more than 60% of surgical cases: in posterior subcapsular cataract visual acuity is adversely affected to a greater extent and earlier than in other types of cataract and requires earlier surgery.

These three types of lens opacities are more frequent in females than in males. We found that they are about 1.5 time as common in women as in men, while, considering only the more advanced grades of lens opacities, they are found from 2.5 to 3 times more frequently in women.

This study confirms that cataract has a high prevalence in the general population and, in addition, shows an unexpected high prevalence of minor lens opacities even in people under 60. This finding is in accordance to the view that factors other than senile changes can contribute to the development of the so-called age-related cataract.

Acknowledgement

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