Prevalence of Cataract and Pseudophakia/Aphakia Among Adults in the United States

*The Eye Diseases Prevalence Research Group**

Objectives: To determine the prevalence of cataract and pseudophakia/aphakia in the United States and to project the expected change in these prevalence figures by 2020.

Methods: Summary prevalence estimates of cataract and of pseudophakia/aphakia were prepared separately for black, white, and Hispanic persons (for whom only cataract surgery data were available) in 5-year age intervals starting at 40 years for women and men. The estimates were based on a standardized definition of various types of cataract: *cortical*, greater than 25% of the lens involved; *posterior subcapsular*, present according to the grading system used in each study; and *nuclear*, greater than or equal to the penultimate grade in the system used. Data were collected from major population-based studies in the United States, and, where appropriate, Australia, Barbados, and Western Europe. The age-, gender-, and race/ethnicity-specific rates were applied to 2000 US Census data, and projected population figures for 2020, to obtain overall estimates.

Results: An estimated 20.5 million (17.2%) Americans older than 40 years have cataract in either eye, and 6.1 million (5.1%) have pseudophakia/aphakia. Women have a significantly (odds ratio=1.37; 95% confidence interval, 1.26-1.50) higher age-adjusted prevalence of cataract than men in the United States. The total number of persons who have cataract is estimated to rise to 30.1 million by 2020; and for those who are expected to have pseudophakia/aphakia, to 9.5 million.

Conclusion: The number of Americans affected by cataract and undergoing cataract surgery will dramatically increase over the next 20 years as the US population ages.

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CATARACT IS THE LEADING cause of blindness in the world today.[1] It is also the leading cause of vision loss in the United States,[2] responsible for some 60% of all Medicare costs related to vision.[3] The effect of age-related cataract can be expected to grow as the US population continues to age. Despite this, few, if any, precise estimates have been made of the prevalence of cataract in the United States on a national basis.

Measuring cataract prevalence for a truly representative national sample would likely be very costly and difficult. However, many scientifically designed, population-based studies have recently provided age-specific estimates of cataract prevalence among population groups relevant to the United States. The current article has attempted to standardize definitions and reporting format between studies to allow the pooling of prevalence figures for cataract and prior cataract surgery. Age-, race/ethnicity-, and gender-specific prevalence rates derived in this fashion have been applied to US Census data from 2000,[4] to estimate the prevalence of lens opacity and pseudophakia/aphakia in the US population as a whole. Estimates for 2020, based on US Census projections of the population,[4] are also presented. These figures represent the first estimates of cataract prevalence in the United States to consider the large number of population-based surveys of eye disease carried out over the last decade or more.

METHODS

GENERAL METHODS AND INCLUSION OF STUDIES

In an initiative sponsored jointly by Prevent Blindness America, Schaumburg, Ill, and the National Eye Institute, Bethesda, Md, a meeting of principal investigators of large studies of eye disease among populations of white, black, and Hispanic persons was convened in Fort Lauderdale, Fla, in May 2001. It was determined by consensus that the morbidity associated with age-related cataract in the United States was best measured by 4 prevalence figures: cataract, prior cataract surgery (eg, pseudophakia/aphakia), and blindness, and low vi-

**The members of the Writing Group for the Eye Diseases Prevalence Research Group, who had complete access to the raw data needed for this report and who bear authorship responsibility for this report, and their affiliations are listed at the end of this article. The Writing Group for this article has no relevant financial interest in this article. A complete list of the members of the Eye Diseases Prevalence Research Group appears on page 494.*

Table 1. Studies Included in Estimates of Prevalence for Cataract and Pseudophakia/Aphakia

Variable	Barbados	BDES	BMES	Proyecto VER	RS	SEE Project	Melbourne VIP
Years study conducted	1988-1992	1988-1990	1992-1994	1999-2000	1990-1993	1993-1995	1991-1998
No. of participants*							
At risk for pseudophakia/aphakia	4314	4874	3632	4715	6723	2505	4685
At risk for cataract	4197	4624	3447	†	†	2100	4610
Cataract grading system used	LOCS II	Wisconsin	Wisconsin	†	†	Wilmer	Wilmer
Age group, y							
40-49	29.1	16.9	NA	33.5	NA	NA	26.6
50-54	12.0	13.6	12.7	16.4	NA	NA	14.4
55-59	12.5	13.0	14.7	12.4	17.2	NA	13.8
60-64	11.9	13.9	17.6	10.8	20.6	NA	13.4
65-69	11.3	14.1	18.5	9.7	19.0	31.0	11.6
70-74	10.9	12.0	14.8	8.2	16.5	33.2	9.6
75-79	7.4	9.2	11.6	5.1	12.7	22.0	5.7
≥80	4.9	7.2	10.0	4.1	14.0	13.8	5.0
Gender							
Female	57.4	56.3	56.7	61.1	59.5	57.7	53.3
Male	42.6	43.7	43.3	38.9	40.5	42.3	46.7
Race/ethnicity							
Black	100.0	NA	NA	NA	NA	26.3	NA
Hispanic	NA	NA	NA	100.0	NA	NA	NA
White	NA	100.0	100.0	NA	100	73.7	100
Crude prevalence							
Any cataract‡	40.9	22.5	22.7	†	†	36.4	23.3
Cortical cataract	17.7	4.5	6.4	†	†	6.6	11.4
Nuclear cataract	5.8	17.2	18.8	†	†	27.6	11.6
Posterior subcapsular cataract	3.4	4.9	6.3	†	†	4.7	4.1
Pseudophakia/aphakia	2.9	5.6	6.2	8.3	5.7	18.6	3.7

Abbreviations: Barbados, Barbados Eye Study, Barbados, West Indies; BDES, Beaver Dam Eye Study, Beaver Dam, Wis; BMES, Blue Mountains Eye Study, Sydney, New South Wales, Australia; LOCS, Lens Opacities Classification System; Melbourne VIP, Vision Impairment Project, Melbourne, Victoria, Australia; NA, not applicable; Proyecto VER, Vision Evaluation Research, Nogales and Tucson, Ariz; RS, Rotterdam Study, Rotterdam, the Netherlands; SEE Project, Salisbury Eye Evaluation, Salisbury, Md.

*Note that the number of participants reported for each study in this table reflects the total contributing data to our estimates in the current article and not necessarily the total number of participants in the original study. Also the number of persons at risk for the cataract subtypes is different from those at risk for cataract surgery in that the latter number includes those with bilateral pseudophakia/aphakia and those unable to undergo cataract grading for various reasons. This larger denominator is used for age, gender, and race/ethnicity distributions shown elsewhere in this table, while only persons at risk for cataract are used to calculate prevalence of the cataract types. Data are given as percentages unless otherwise indicated.

†These studies provided only information on pseudophakia/aphakia and not on cataract prevalence.

‡Any cataract is defined as the presence of 1 or more of the following in either eye: posterior subcapsular cataract defined by the grading system in each study, cortical cataract occupying 25% or more of the lens visible through a dilated pupil, or nuclear cataract greater than or equal to the penultimate grade in the system used (ie, grade ≥3 in the Wilmer Cataract Grading System[12] and in the LOCS II[13] and grade ≥4 in the Wisconsin Cataract Grading System[14]). For the Barbados Eye Study only, any cataract is based on the LOCS II grades or greater than or equal to that for all 3 subtypes.

sion associated with cataract. The current article presents the estimated prevalence of cataract and of pseudophakia/aphakia in the US population 40 years and older in 2000, and the projected prevalence in 2020. Estimates of the prevalence of cataract-associated low vision and blindness in the United States are reported in a companion article in this issue.[5]

An attempt was made to include all scientifically valid, population-based studies of cataract relating to white, black, or Hispanic persons published in English after 1990 (**Table 1**).[6-10] Few, if any, population-based studies published before this date measured lens opacity according to predetermined photographic standards. Many earlier studies also defined cataract with reference to the visual acuity of the subject, which is difficult to interpret because of the inability to adjust for competing causes of vision loss. The cutoff date was further chosen to minimize potential inaccuracies due to changing rates of cataract extraction and other cohort effects. While studies from Europe and Australia were included in estimates for white persons, potentially relevant studies from Africa[11] were excluded from estimates for black persons owing to concerns over the potential effect of rates of cataract surgery significantly different from the United States.

STANDARDIZATION AMONG STUDIES

Investigators from studies listed in Table 1 provided data tables listing the number of persons having cataract and pseudophakia/aphakia in either eye by 5-year age interval, gender, and (where relevant) race/ethnicity. The number of persons at risk in each stratum was also provided. Cataract was defined as the presence of 1 or more of the following in either eye:

- Posterior subcapsular (PSC) cataract is present according to the grading system used. (The Wilmer Cataract Grading System[12] requires the presence of any PSC opacity to define PSC; the Lens Opacities Classification System [LOCS II][13] defines PSC as present if the posterior lesion occupies >3% of the visible area of the lens, ie, a LOCS II PSC grade ≥2; and in the Wisconsin Cataract Grading System,[14] a PSC is present if the posterior lesion occupies ≥5% of any grid or approximately 0.625% the visible lens.)
- Cortical cataract occupying 25% or more of the lens visible through a dilated pupil.
- Nuclear cataract greater than or equal to the penultimate grade in the system used (ie, grade ≥3 in the Wilmer Cata-

ract Grading System[12] and in LOCS II[13] and grade ≥4 in the Wisconsin Cataract Grading System[14]).

Estimates for prevalence of cataract and pseudophakia/aphakia among black persons in the current article were based on studies conducted in Salisbury, Md, [9] and Barbados, West Indies.[8] The Salisbury Eye Evaluation (SEE) Project only examined subjects 65 years and older. Because of the differences between the Barbados and Salisbury studies in the cutoff used to define cataract, it was impossible to pool the prevalence estimates from these studies. Age- and gender-specific prevalence data from the SEE Project were used to estimate prevalence for black persons 65 years and older. To estimate age- and gender-specific prevalence for individuals aged 40 through 64 years, we applied gender-specific "correction factors" to the Barbados Eye Study 5-year prevalence rates in this age range. The correction factors were derived by dividing the reported prevalence for Barbados Eye Study subjects aged 65 years and older for each gender- and age-specific stratum by the comparable figure for the SEE Project. These fractions for all age-strata were averaged separately for the 2 genders. The correction factors (0.32 for males and 0.42 for females) were then applied to the Barbados Eye Study data for each age interval in the range 40 through 64 years to produce age- and gender-specific prevalence estimates of cataract and pseudophakia/aphakia among black persons in this age range. In essence, this method imputes rates for the SEE Project in the younger-aged groups by adjusting the Barbados Eye Study rates based on the differences between the 2 studies found in the older-aged groups.

To derive age- and gender-specific estimates of the prevalence of cataract among Hispanics and other races/ethnicities (East Asian, Native American, and others), a nonweighted average of the values for white and black persons in each age and gender cell was used. Such values are not useful for estimating the prevalence of cataract in these groups but were judged to be the best available approximation for use in generating overall US population estimates by age and gender. Unpublished data for the prevalence of pseudophakia/aphakia were available for Hispanic persons (S. West, PhD, communication via e-mail, December 1, 2002) and were used in our estimates for this outcome. Age- and gender-specific prevalence of pseudophakia/aphakia among other races/ethnicities was estimated using a nonweighted average of the values for white, black, and Hispanic persons in each age- and gender-specific stratum.

AGE-SPECIFIC PREVALENCE ESTIMATES

The age-specific prevalence estimates for cataract and pseudophakia/aphakia for white persons were derived in 2 steps. First, pooled prevalence proportions were estimated for each gender- and age-specific stratum using minimum variance linear estimation. Stratum-specific proportions from each study were transformed using a logarithm odds transformation. Proportion variances were estimated based on the binomial distribution. The Cochran test for homogeneity was used to evaluate the between-study variation for the pooled proportions. Second, logistic regression models were fit to the pooled prevalence proportions using the midpoint of each age interval as the independent variable. Models were fit separately for males and females. For black persons, logistic regression models were fit to the age- and gender-specific estimates derived from the SEE Project and the Barbados Eye Study as described in the "Standardization Among Studies" subsection.

ESTIMATES OF PREVALENCE IN THE US POPULATION

The number of cases of cataract and of pseudophakia/aphakia in the United States in each race/ethnicity, gender, and age category was estimated by applying the modeled prevalence rate for each year of age to the 2000 US Census population and summing over the age range for each 5-year age category. Projected estimates were derived applying the modeled rates for 2000 to the US Census middle-series projections for 2020. Constant age- and gender-specific rates were assumed over this period for both cataract and cataract surgery. Stratum-specific US prevalence rates were computed by dividing the total number of estimated cases for each stratum by the stratum-specific US population.

Table 2. Prevalence of Cataract by Age, Gender, and Race/Ethnicity*

Gender/Age, y	Prevalence per 100 Individuals (95% CI)	
	White Persons	Black Persons
Females		
40-49	1.9 (1.2-2.8)	2.2 (1.4-3.5)
50-54	5.0 (4.0-6.2)	7.3 (5.7-9.3)
55-59	9.4 (7.7-11.5)	12.8 (10.2-16.0)
60-64	16.9 (14.1-20.0)	20.1 (16.4-24.2)
65-69	27.7 (24.1-31.6)	28.5 (24.3-33.1)
70-74	41.0 (36.9-45.1)	37.4 (32.6-42.5)
75-79	54.7 (50.2-59.1)	46.1 (40.1-52.2)
≥80	76.6 (71.2-81.2)	60.9 (51.0-69.9)
Males		
40-49	2.8 (2.1-3.7)	1.7 (1.1-2.5)
50-54	4.9 (4.2-5.7)	4.5 (3.6-5.6)
55-59	8.2 (7.0-9.5)	7.6 (6.2-9.3)
60-64	13.8 (12.1-15.7)	11.9 (9.9-14.2)
65-69	22.4 (20.1-24.8)	17.5 (15.0-20.3)
70-74	33.9 (31.2-36.8)	24.1 (21.0-27.5)
75-79	47.2 (43.9-50.4)	31.3 (27.1-36.0)
≥80	71.3 (67.0-75.2)	46.2 (37.9-54.6)

Abbreviation: CI, confidence interval.
*Significant lens opacity was defined as the presence of 1 or more of the following in either eye: posterior subcapsular cataract of 1.0 mm or more, cortical cataract occupying 25% or more of the lens visible through a dilated pupil, or nuclear cataract greater than or equal to the penultimate grade in the system used (ie, grade ≥3 in the Wilmer Cataract Grading System[12] and in the Lens Opacities Classification System II[13] and grade ≥4 in the Wisconsin Cataract Grading System[14]).

STATISTICAL TESTS

The overall fit for each logistic regression model was evaluated using the F test for analysis of variance and the r^2 measure for proportion of explained variation. Age and race/ethnicity effects were tested using the model Wald χ^2 test statistics. Odds ratios (ORs) for race/ethnicity were derived from logistic regression coefficients for the appropriate racial comparisons. Tests for gender differences were based on the observed age-, race/ethnicity-, and gender-specific rates from each study. Separate Mantel-Haenszel χ^2 tests were done by race/ethnicity controlling for both age and study effects.

RESULTS

The pooled age-specific prevalence figures for cataract increased with age for both black and white persons ($P<.001$ for both, χ^2 test) (**Table 2**). Women had a higher prevalence of cataract among both blacks (OR=1.75; 95% confidence interval [CI], 1.18-2.56) and whites (OR=1.35; 95% CI, 1.23-1.49). The age-adjusted prevalence of cataract did not differ between blacks and whites for women

Table 3. Prevalence of Pseudophakia/Aphakia by Age, Gender, and Race/Ethnicity*

Gender/Age, y	Prevalence per 100 Individuals (95% CI)		
	White Persons	Black Persons	Hispanic Persons
Females			
40-49	0.5 (0.4-0.6)	0.2 (0.1-0.3)	1.4 (0.9-2.1)
50-54	0.8 (0.7-0.9)	0.9 (0.7-1.2)	2.1 (1.7-2.7)
55-59	1.4 (1.1-1.6)	1.9 (1.4-2.5)	3.6 (2.9-4.4)
60-64	2.5 (2.1-2.9)	3.6 (2.8-4.7)	6.3 (5.1-7.7)
65-69	4.6 (4.0-5.2)	6.3 (5.0-7.8)	11.2 (9.4-13.2)
70-74	8.2 (7.3-9.2)	10.0 (8.0-12.3)	19.0 (16.5-21.9)
75-79	14.0 (12.5-15.8)	14.8 (11.7-18.6)	30.2 (26.4-34.2)
≥80	33.5 (28.8-38.6)	27.1 (19.2-36.8)	52.1 (45.6-58.4)
Males			
40-49	0.8 (0.6-1.1)	0.4 (0.1-1.0)	0.8 (0.5-1.2)
50-54	1.2 (1.0-1.4)	0.6 (0.3-1.2)	1.4 (1.1-1.8)
55-59	1.9 (1.6-2.2)	1.1 (0.6-2.0)	2.6 (2.0-3.3)
60-64	3.1 (2.6-3.6)	1.8 (1.0-3.1)	5.2 (4.2-6.5)
65-69	5.2 (4.5-5.9)	3.0 (1.8-4.9)	10.4 (8.6-12.5)
70-74	8.5 (7.6-9.6)	4.9 (3.2-7.6)	19.6 (16.8-22.8)
75-79	13.6 (12.0-15.4)	7.8 (4.8-12.6)	33.4 (29.1-38.0)
≥80	29.6 (25.0-34.6)	17.5 (8.0-33.9)	59.8 (52.9-66.4)

Abbreviation: CI, confidence interval.

(OR=1.03; 95% CI, 0.97-1.09) but among men was significantly higher for whites (OR=1.09; 95% CI, 1.02-1.16) than blacks.

The prevalence of pseudophakia/aphakia also increased with age for black, white, and Hispanic persons of both genders ($P<.001$, χ^2 test) (**Table 3**). Pseudophakia/aphakia was significantly more common among Hispanics (data from the Proyecto VER [Visual Evaluation Research], Nogales and Tucson, Ariz, only) compared with whites of both genders (OR=1.52; 95% CI, 1.37-1.68) and blacks of both genders (OR=3.04; 95% CI, 2.52-3.56), and among white compared with black males (OR=1.83; 95% CI, 1.17-2.86).

Applying these age-, race/ethnicity-, and gender-specific prevalence figures to the 2000 US Census data, there were an estimated 20.5 million persons (95% CI, 20.0-20.9) 40 years and older with cataract in the United States, a prevalence of 17.2% (95% CI, 16.8-17.5%) (**Table 4**). An estimated 6.1 million (95% CI, 5.7-6.5) Americans older than 40 years had pseudophakia/aphakia in 2000, a prevalence of 5.1% (95% CI, 4.8-5.5%) (**Table 5**).

According to our projections, based on US Census estimates for the population in 2020, the number of persons with cataract will rise to 30.1 million by 2020, an increase of 50%. Americans with pseudophakia/aphakia were estimated to increase in number by almost 60% to 9.5 million by 2020. The number of Hispanic persons with pseudophakia/aphakia was predicted to almost triple to 1.6 million.

When age- and gender-specific prevalence rates for all included studies were examined together, the prevalence of cataract (**Figure 1**) and pseudophakia/aphakia (**Figure 2**) in the US studies did not seem to differ systematically from those conducted in Australia and Europe. Derived gender- and age-specific prevalence rates from this study were also applied to the 2000 populations of Australia[15] and Western Europe.[15] An estimated 1.4 million persons (prevalence 17.2%) were estimated to be affected by cataract in Australia and 36.0 million persons (prevalence 19.3%) in Western Europe. The corresponding figures for pseudophakia/aphakia were 380 000 (4.7%) and 9.8 million (5.3%), respectively.

COMMENT

Our estimates indicate that cataract prevalence will increase dramatically in the coming decades. The large increase in cataract surgical procedures predicted for the US population as a whole is also of significant health policy importance. Treatment for cataract already accounts for some 60% of vision-related Medicare expenditures.[3] Further growth in this area will have a substantial effect on health care spending and, potentially, the fiscal stability of the Medicare system.

In determining which studies to include in this article, the decision was made to use only data that had been collected on a population basis since 1990, using a system of cataract grading with predetermined standards. This led to the omission of the Framingham Eye Study,[16] an important early study that did report on the prevalence of lens opacities, but did not use a grading system with photographic standards, and assigned lens opacity grades based in part on visual acuity. This approach could not be reconciled with modern grading systems based entirely on the photographic or slitlamp appearance of lens opacities.

Few population-based studies in the United States have reported on cataract prevalence and, thus, the inclusion of data from the Rotterdam Study, Rotterdam, the Netherlands; Blue Mountains Eye Study, Sydney, New South Wales, Australia; and the Melbourne Visual Impairment Project, Melbourne, Victoria, Australia, increased the power of our report, thus, allowing narrower confidence limits in our estimates, especially for the small, but important, population of the very old. Estimates for white Americans aged 40 through 64 years would otherwise have been derived from a single report (Beaver Dam Eye Study, Beaver Dam, Wis). Most Australians immigrated originally from the same European countries from which white Americans came (notably England, Ireland, Scotland, Germany, Italy, and Greece). Still, there are various factors that might lead to differences in cataract prevalence between countries. These include latitude (as a surrogate for exposure to cataractogenic UV-B light),[17] differential rates of cataract surgery, and possible cultural differences with regard to diet, tobacco smoking, and alcohol use. However, our study did not find systematic differences between European, Australian, and US studies for the prevalence of cataract or of pseudophakia/aphakia. The generally similar rates across diverse studies of white persons indicate that pooling is appropriate and suggest that the estimates are likely to be reliable.

The cataract prevalence data available from population-based studies for persons of African descent are sparse; our estimates depended on statistical manipulation of data from the Barbados Eye Study to obtain any estimates for black Americans younger than 65 years. Prevalence of cata-

Table 4. Estimated Prevalence of Cataract in the United States by Age, Gender, and Race/Ethnicity*

Variable	No. of Persons (in Thousands)		Total US Population†	
	White	Black	No. of Persons in Thousands (95% CI)	Prevalence per 100 Individuals (95% CI)
Age, y				
Females				
40-49	320	65	462 (343-581)	2.1 (1.6-2.7)
50-54	340	69	483 (408-557)	5.4 (4.5-6.2)
55-59	507	90	693 (589-798)	10.0 (8.5-11.5)
60-64	740	117	984 (853-1115)	17.4 (15.0-19.7)
65-69	1125	142	1425 (1271-1579)	27.8 (24.8-30.8)
70-74	1654	162	1996 (1827-2165)	40.3 (36.9-43.7)
75-79	2010	155	2330 (2163-2496)	53.3 (49.5-57.1)
≥80	3849	265	4351 (4084-4619)	71.1 (66.7-75.4)
Subtotal	**10 547**	**1066**	**12 724** (12 278-13 171)	20.0 (19.3-20.7)
Males				
40-49	465	42	584 (458-711)	2.8 (2.2-3.4)
50-54	329	36	420 (368-471)	4.9 (4.3-5.5)
55-59	422	44	528 (465-591)	8.1 (7.1-9.1)
60-64	563	55	695 (621-769)	13.5 (12.1-15.0)
65-69	804	64	957 (872-1042)	21.8 (19.8-23.7)
70-74	1106	69	1273 (1182-1365)	32.6 (30.3-35.0)
75-79	1220	63	1374 (1288-1459)	45.1 (42.3-47.9)
≥80	1723	85	1921 (1810-2031)	62.7 (59.1-66.3)
Subtotal	**6633**	**458**	**7752** (7500-8003)	13.9 (13.5-14.4)
Both genders				
40-49	785	107	1046 (873-1220)	2.5 (2.1-2.9)
50-54	669	105	902 (812-993)	5.1 (4.6-5.6)
55-59	929	134	1221 (1100-1343)	9.1 (8.2-10.0)
60-64	1304	172	1679 (1528-1829)	15.5 (14.1-16.9)
65-69	1929	206	2382 (2207-2558)	25.0 (23.1-26.8)
70-74	2761	231	3270 (3077-3462)	36.9 (34.7-39.1)
75-79	3230	219	3703 (3516-3891)	49.9 (47.4-52.5)
≥80	5572	350	6272 (5982-6562)	68.3 (65.1-71.4)
Total	**17 180**	**1524**	**20 476** (19 964-20 988)	17.2 (16.7-17.6)

Abbreviation: CI, confidence interval.

*Significant lens opacity was defined as the presence of 1 or more of the following in either eye: posterior subcapsular cataract of 1.0 mm or more, cortical cataract occupying 25% or more of the lens visible through a dilated pupil, or nuclear cataract greater than or equal to the penultimate grade in the system used (ie, grade ≥3 in the Wilmer Cataract Grading System[12] and in the Lens Opacities Classification System II[13] and grade ≥4 in the Wisconsin Cataract Grading System[14]).

†All estimates are based on the 2000 US Census population.[4] Estimates for the prevalence of cataract in the total US population includes estimates for Hispanic persons and other races/ethnicities (Asian, Native American, Alaska Native, Native Hawaiian and other Pacific Islander, and any other race/ethnicity) and those designating more than 1 race on the 2000 US Census form. These estimates were derived from models using an unweighted average of the pooled age- and gender-specific rates for white and black persons. The age- and gender-specific estimates for cataract prevalence derived in this way are available at: http://www.nei.nih.gov/eyedata/.

ract surgery appears somewhat lower in Barbados than for black Americans (data not shown). Other cultural factors as outlined earlier might be expected to differ between the 2 countries. Nevertheless, the only alternative would have been to assume that the prevalence of cataract and cataract surgery among black and white Americans is the same, an assumption that seems unlikely to be correct.[9] Some studies of cataract prevalence in Africa exist[11] that might have increased the power of our estimates. However, there are significant differences between the United States and Africa in availability of cataract surgery and in behaviors potentially affecting lens clarity, rendering such data less useful for our purposes.

Other modern prevalence studies exist that might have provided data relevant to this article. We have chosen not to attempt to incorporate data for Chinese populations in Singapore[18] and elsewhere as US Census data identify individuals as being of East Asian origin only, without providing the exact country of origin. It is unclear whether estimates derived from Chinese living in Singapore would improve the accuracy of our data for persons originating from Japan, Korea, Vietnam, the Philippines, and others, now residing in the United States. Other population-based studies of cataract prevalence among European-derived persons are also available,[19] but it was impossible for us to obtain data from these studies in a format that allowed these data to be incorporated into the current article.

One difficulty of combining cataract prevalence data from different studies lies in attempting to divide an inherently continuous variable such as lens opacity into discrete units and in reconciling the differing grading systems that have been used to do so. This study followed the consensus opinion of a group of experts, the principal investigators of the studies cited herein, in setting an arbitrary cutoff for cataract. As cortical cataract is gen-

Table 5. Estimated Prevalence of Cataract in the United States by Age, Gender, and Race/Ethnicity*

Variable	No. of Persons (in Thousands)			Total US Population†	
	White	Black	Hispanic	No. of Persons (in Thousands) (95% CI)	Prevalence per 100 Individuals (95% CI)
Age, y					
Females					
40-49	81	6	31	127 (102-153)	0.6 (0.5-0.7)
50-54	54	8	15	84 (75-94)	0.9 (0.8-1.0)
55-59	74	13	18	114 (100-127)	1.6 (1.4-1.8)
60-64	111	21	25	169 (150-187)	3.0 (2.7-3.3)
65-69	190	31	37	274 (248-301)	5.3 (4.8-5.9)
70-74	338	43	51	455 (415-496)	9.2 (8.4-10.0)
75-79	524	50	57	656 (594-719)	15.0 (13.6-16.4)
≥80	1613	115	110	1890 (1625-2154)	30.9 (26.5-35.2)
Subtotal	**2984**	**288**	**345**	**3769** (3491-4047)	5.9 (5.5-6.4)
Males					
40-49	137	9	18	171 (129-213)	0.8 (0.6-1.0)
50-54	79	5	9	98 (84-113)	1.1 (1.0-1.3)
55-59	95	6	12	119 (102-136)	1.8 (1.6-2.1)
60-64	125	8	18	160 (139-181)	3.1 (2.7-3.5)
65-69	185	11	28	235 (208-262)	5.3 (4.7-5.9)
70-74	278	14	40	347 (312-381)	8.9 (8.0-9.8)
75-79	351	16	44	429 (384-473)	14.1 (12.6-15.5)
≥80	663	30	68	791 (661-921)	25.8 (21.6-30.1)
Subtotal	**1916**	**99**	**237**	**2350** (2196-2503)	4.2 (3.9-4.5)
Both genders					
40-49	218	15	49	299 (249-348)	0.7 (0.6-0.8)
50-54	134	14	24	183 (165-200)	1.0 (0.9-1.1)
55-59	169	19	30	233 (211-254)	1.7 (1.6-1.9)
60-64	236	29	44	329 (301-356)	3.0 (2.8-3.3)
65-69	375	42	65	509 (472-547)	5.3 (4.9-5.7)
70-74	616	57	91	802 (748-855)	9.1 (8.4-9.7)
75-79	875	66	102	1085 (1008-1161)	14.6 (13.6-15.7)
≥80	2277	145	178	2681 (2386-2975)	29.2 (26.0-32.4)
Total	**4900**	**387**	**582**	**6119** (5801-6436)	5.1 (4.9-5.4)

Abbreviation: CI, confidence interval.

*All estimates are based on the 2000 US Census population.[4] Estimates for the prevalence of pseudophakia/aphakia in the total US population include estimates for other races/ethnicities (Asian, Native American, Alaska Native, Native Hawaiian and other Pacific Islander, and any other race/ethnicity) and those designating more than 1 race on the 2000 US Census form. These estimates were derived from models using an unweighted average of the pooled age- and gender-specific rates for white, black, and Hispanic persons. The age- and gender-specific estimates for pseudophakia/aphakia prevalence derived in this way are available at: http://www.nei.nih.gov/eyedata/.

erally measured by the area opacified on retroillumination photographs or at the slitlamp, it was simple to pick a cutoff area or proportion of the lens involved and then choose the grade in each system that came closest to approximating that area. For PSC, it is likely that the Wilmer Grading System,[12] which only required that PSC be present, might have included some opacities that would not have reached the standard for PSC in LOCS II[13] (>3% of the visible lens area involved) or the Wisconsin Cataract Grading System[14] (≥ 0.625% of the visible lens area).

Nuclear cataract is graded in all of the systems in current use with reference to standard photographs depicting different degrees of opalescence (brunescence as measured in the LOCS II[13] and III[20] systems was not considered in our study definition of cataract). In choosing the penultimate nuclear category in each system as our cutoff, we have attempted to identify a degree of opalescence that is approximately the same in each of the studies cited. However, small differences in the cutoffs used in the various grading systems, and the impossibility of arriving at any definite equality of visual significance between different cataract types, will to some extent limit the accuracy of our conclusions with regard to cataract prevalence. The widespread use of more objective and universal systems to quantify lens opacity may improve accuracy in this area in the future, but it seems unlikely that any objective equivalence of grades of the different opacity types can ever be determined. Providing separate prevalence estimates for the different cataract types might have avoided this problem, but it was felt that policy makers required a summary prevalence figure for cataract.

The increasing prevalence of cataract and pseudophakia/aphakia with age, and among women, has previously been reported in many studies.[21] The higher prevalence of pseudophakia/aphakia among Hispanic persons when compared with white and black persons has not, to the best of our knowledge, been documented previously. However, this finding is based on a single study and might possibly be influenced by practice patterns specific to the 2 locales (ie, Nogales and Tucson, Ariz) included in the Proyecto VER sample. Further, this study of Mexican Americans is not necessarily representative of the full range of Hispanic persons in the United States, which includes Cuban Americans, Puerto Ricans, and persons from elsewhere in Latin

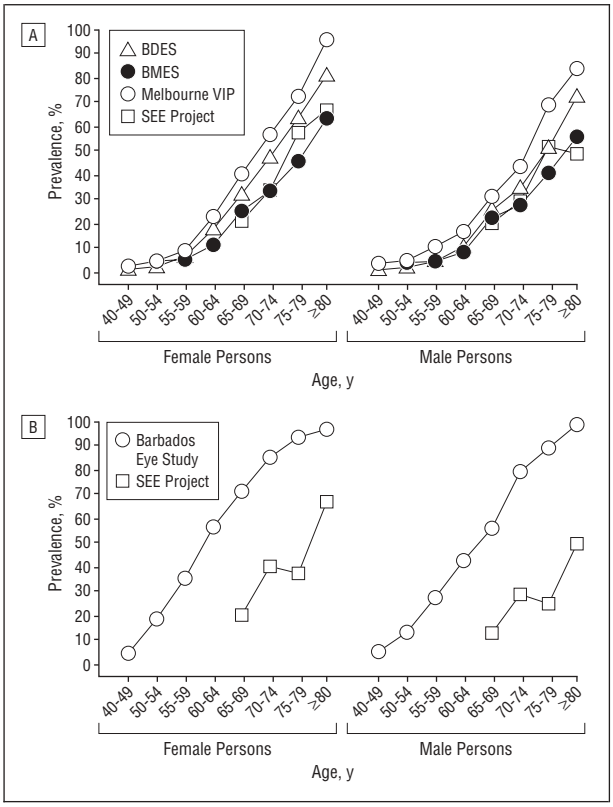

Figure 1. A, Prevalence of cataract by age among white persons in 4 population-based studies. B, Prevalence of cataract by age among black persons in 2 population-based studies. BDES indicates Beaver Dam Eye Study, Beaver Dam, Wis; BMES, Blue Mountains Eye Study, Sydney, New South Wales, Australia; Melbourne VIP, Melbourne Visual Impairment Project, Melbourne, Victoria, Australia; SEE Project, Salisbury Eye Evaluation Project, Salisbury, Md. The Barbados Eye Study was conducted in Barbados, West Indies.

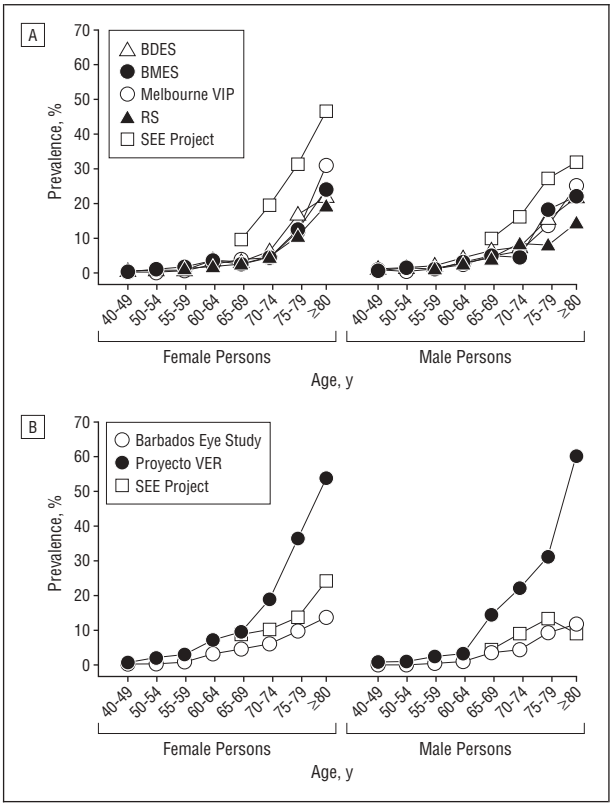

Figure 2. A, Prevalence of pseudophakia and aphakia by age among white persons in 5 population-based studies. BDES indicates Beaver Dam Eye Study, Beaver Dam, Wis; BMES, Blue Mountains Eye Study, Sydney, New South Wales, Australia; Melbourne VIP, Melbourne Visual Impairment Project, Melbourne, Victoria, Australia; RS, Rotterdam Study, Rotterdam, the Netherlands; and SEE Project, Salisbury Eye Evaluation Project, Salisbury, Md. B, Prevalence of pseudophakia and aphakia by age among Hispanic (Proyecto VER [Vision Evaluation Research], Nogales and Tucson, Ariz) and black persons (Salisbury Eye Evaluation Project and the Barbados Eye Study, Barbados, West Indies) in 3 population-based studies.

America. The ongoing Los Angeles Latino Eye Study (LALES)[22] will provide an opportunity to further study rates of cataract extraction among Hispanic Americans. If, in fact, Hispanic persons undergo cataract extraction at a significantly higher rate than other racial groups, this will be of increasing importance owing to the rapid growth of this segment of the US population.

Application of this study's findings cannot be made without a clear awareness of its weaknesses. As mentioned earlier, our estimates for cataract prevalence in the United States rely in part on data from Western Europe, Australia, and Barbados, areas that may differ from the United States in cataract surgical rates and many other cultural factors likely to influence the prevalence of lens opacity. For some groups, such as Hispanics and blacks, our prevalence estimates rely on the results of a single study, and are, thus, likely to be affected by local variations in surgical practices and by dietary, sun exposure, tobacco smoking, and genetic profiles that are highly specific to the population reported. There are many important groups that are unlikely to be represented by any of the study populations cited by us, including the urban poor and those living in the rural southeastern part of the United States.

Our projections of the prevalence of cataract and pseudophakia/aphakia in 2020 are based on assumptions of constant incidence. Such assumptions may not be accurate, particularly for future rates of cataract surgery, which are known to fluctuate with levels of reimbursement[23] among other factors. Finally, as discussed in detail earlier, the accuracy of our estimates of cataract prevalence must be limited to some extent by the necessity of combining results using different grading systems.

Nevertheless, these estimates are the first to combine the results of several population-based studies of cataract prevalence with newly completed 2000 US Census data and population projections. As such, they are likely to provide the most complete information available on the most important cause of visual disability in our country. Our projections of a greatly increased cataract burden and need for surgical services, despite their limitations, almost certainly reflect the realistic scope of this problem in a rapidly aging population. Without strategies to prevent or delay the onset of lens opacity, the health care system will be challenged with an unprecedented demand for cataract care.

In addition to underscoring the need for further research into cataract prevention strategies, this study also highlights the complete lack of data on the prevalence of eye disease among important population groups such as Asian Americans. There is also a clear need, if cataract prevalence data are to be of practical use to health policy planners at a national or international level, to de-

Members of the Eye Diseases Prevalence Research Group

The members of the Eye Diseases Prevalence Research group are as follows: *Baltimore Eye Survey, Baltimore, Md:* James M. Tielsch; Alfred Sommer; Joanne Katz; Harry A. Quigley. *Barbados Eye Studies, Barbados, West Indies:* M. Cristina Leske; Suh-Yuh Wu; Barbara Nemesure; Anselm Hennis; Leslie Hyman; Andrew Schachat. *Beaver Dam Eye Study, Beaver Dam, Wis:* Barbara E. K. Klein; Ronald Klein; Kristine E. Lee; Scot E. Moss; Sandra C. Tomany. *Blue Mountains Eye Study, Sydney, New South Wales, Australia:* Paul Mitchell; Jie Jin Wang; Elena Rochtchina; Wayne Smith; Robert G. Cumming; Karin Attebo; Jai Panchapakesan; Suriya Foran. *Melbourne Visual Impairment Project, Melbourne, Victoria, Australia:* Hugh R. Taylor; Cathy McCarty; Bickol Mukesh; LeAnn M. Weih; Patricia M. Livingston; Mylan Van Newkirk;, Cara L. Fu; Peter Dimitrov; Matthew Wensor; Yury Stanislavsky. *Proyecto VER (Vision Evaluation Research), Nogales and Tucson, Ariz:* Sheila West; Jorge Rodriguez (deceased); Aimee Broman; Beatriz Muñoz; Robert Snyder. *Rotterdam Study, Rotterdam, the Netherlands:* Paulus T. V. M. de Jong; Johannes R. Vingerling; Roger C. W. Wolfs; Caroline C. W. Klaver; Albert Hofman; Redmer van Leeuwen;M. Kamran Ikram; Simone de Voogd. *Salisbury Eye Evaluation Project, Salisbury, Md:* Sheila West;, Gary Rubin; Karen Bandeen Roche; Beatriz Muñoz; Kathy Turano;, Oliver Schein; Donald Duncan; Susan Bressler.

Resource Centers

Coordinating Center: *David S. Friedman; Nathan G. Congdon; John H. Kempen; Benita J. O'Colmain.*
National Eye Institute, Bethesda, Md: *Frederick L. Ferris III.*

velop methods of comparing existing cataract grading systems or to agree on a single system for universal use.[24]

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The Writing Group members for the Eye Diseases Prevalence Research Group who had complete access to the raw data needed for this report and who bear authorship responsibility for this report are Nathan Congdon, MD, MPH (chairperson); Johannes R. Vingerling, MD, PhD; Barbara E. K. Klein, MD, MPH; Sheila West, PhD; David S. Friedman, MD, MPH; John Kempen MD, PhD; Benita O'Colmain, MPH; Suh-Yuh Wu, MA; Hugh R. Taylor, MD; and Jie Jin Wang, Mmed, MApplStat, PhD.

From the Dana Center for Preventive Ophthalmology, Wilmer Eye Institute, The Johns Hopkins University (Drs Congdon, West, Friedman, and Kempen); Department of Ophthalmology, Erasmus Medical Center, Rotterdam, the Netherlands (Dr Vingerling); Department of Ophthalmology, University of Wisconsin, Madison (Dr Klein); Macro International, Inc, Calverton, Md (Ms O'Colmain); Department of Preventive Medicine, School of Medicine, Stony Brook State University of New York at Stony Brook (Ms Wu); Centre for Eye Research Australia, University of Melbourne, East Melbourne, Victoria, Australia (Dr Taylor); Department of Ophthalmology, University of Sydney, Centre for Vision Research, Westmead, New South Wales, Australia (Dr Wang); Department of Epidemiology and Biostatistics, School of Public Health and Health Services, George Washington University Medical Center, Washington, DC (Ms O'Colmain).

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Corresponding author: Nathan Congdon, MD, MPH, Wilmer Eye Institute, Wilmer 120, 600 N Wolfe St, Baltimore, MD 21287 (e-mail: ncongdon@jhmi.edu).

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