

Prevalence of age-related macular degeneration in Spain

Spanish Eyes Epidemiological (SEE) Study Group*

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ABSTRACT

Aim To estimate the prevalence of age-related maculopathy (ARM) and age-related macular degeneration (AMD) in the Spanish population aged ≥ 65 years.

Methods Individuals were selected by random stratified sampling of census data from eight Spanish health districts encompassing a wide geographic area. Participants underwent an ophthalmologic evaluation including fundus imaging, and ARM and AMD were defined according to the International ARM Epidemiological Study Group classification. The age- and gender-adjusted prevalences and CIs for ARM and neovascular and atrophic forms of AMD were calculated.

Results Of the 3028 individuals invited to participate, 2132 attended the ophthalmologic evaluation (840 men (70.9% response) and 1292 women (69.7% response); 978 aged 65–74 years (77.6% response), 1154 aged ≥ 75 years (65.3% response)). The overall prevalence of ARM and AMD was 10.3% (95% CI 8.7% to 11.8%) and 3.4% (95% CI 2.5% to 4.3%), respectively. AMD increased from 1.3% in individuals aged 65–74 years to 8.5% in those aged ≥ 80 years. Neovascular and atrophic AMD accounted for 1.9% and 1.5% of individuals, respectively.

Conclusions The prevalence of AMD in this large, population-based Spanish sample was similar to that observed in other large-scale population-based studies. However, the prevalence of ARM was lower than found in similar studies.

INTRODUCTION

Age-related maculopathy (ARM) is essentially characterised by the presence of drusen.¹ The term encompasses a wide range of retinal disorders and visual impairment. Progression of maculopathy eventually leads to age-related macular degeneration (AMD), which is also one of the principal causes of reduced vision and legal blindness among the elderly in developed countries.² Even when AMD does not lead to blindness, there is a strong negative impact on independence and quality of life.³

Two main forms of AMD have been identified⁴: geographic atrophy associated with extensive loss of the choriocapillaris and overlying retinal pigment epithelium and neovascular AMD—the more aggressive form—in which blood and serum leakage from newly formed blood vessels in the macular region of the retina causes irreversible damage and progressive vision loss. Although the neovascular form is generally less common,⁵ it is responsible for a larger proportion of severe loss of visual acuity related to AMD.⁶ Tobacco smoking is the main

modifiable risk factor for the development of AMD.⁷ In addition to age, the disease has been associated with family history, exposure to sunlight, light-coloured iris, dietary factors⁸ and, more recently, certain genetic factors.⁹ A link between cardiovascular disease and AMD has also been reported,¹⁰ possibly as a result of inflammatory processes common to the two diseases.¹¹

The prevalence of ARM and AMD in Spain is of particular interest since only limited data are currently available on southern European countries. To date, however, although some studies have reported prevalences for specific groups within the Spanish population,^{12–13} none has addressed the overall prevalence of macular degeneration. In view of the paucity of population-based epidemiological data on ARM in Spain and the expected increase in absolute prevalence of ARM with increasing age of the population,¹⁴ we undertook the present study. The aim was to collect epidemiological data on prevalence among individuals aged 65 years or more, according to rigorous internationally standardised methodology.¹⁵

METHODS

This was a population-based, cross-sectional, epidemiological study of ARM and AMD in the Spanish population. The protocol, which was approved by the ethics committee of Hospital La Paz (Madrid, Spain), was in compliance with guidelines on Good Clinical Practice and the Declaration of Helsinki (2002). The sample was obtained by random stratified sampling. The strata corresponded to individual health districts, which are existing geographic regions of Spain in which all members of the resident population are assigned to a specialist care unit. The sample comprised eight health districts in six Spanish provinces chosen to ensure adequate geographic spread: Madrid (central Spain, 311 participants), Oviedo (northwest Spain, 318 participants), Barcelona and Hospitalet de Llobregat (northeast Spain, 421 participants), Valencia (eastern Spain, 305 participants), Seville and Dos Hermanas (southern Spain, 474 participants) and Santa Cruz de Tenerife (Canary Islands, 303 participants). In each health district, sample elements were selected by simple random sampling of all individuals aged at least 65 years who were resident in that district according to current census data. Thus, the sampling process ensured that all contacts were directed towards individuals who were resident in each district and included individuals with public healthcare coverage and those with additional private healthcare plans. The sample was divided into the following main age groups: 65–74 years and ≥ 75 years. The weighting

assigned to health district reflected the percentage of individuals in each age group registered in that district. The relative weighting of the different age groups did not, however, reflect the age profile (see below).

Sample size and statistical analysis

To ensure that a random sample was obtained and to increase the response rate, the fieldwork was organised in various stages. First, initial telephone contact was made to explain the aims of the study and invite individuals to participate. Each participant was then sent a letter containing detailed information about the study and confirming that it would take place at their corresponding referral hospital. The letter was accompanied by a leaflet on AMD. Afterwards, each participant was contacted again, either by telephone or by personal visit according to individual needs, to confirm the date and time of the hospital appointment. The use of health districts as sampling units in the first step favours participation since all participants were seen in the corresponding referral hospital for their health area. All selected individuals who had agreed to participate but who did not attend their appointment were offered another appointment in an effort to increase participation. Furthermore, attendance was encouraged by providing transport to and from the hospital for any individual with mobility restrictions or who simply requested this service.

At first visit, the nature of the study was explained again in detail and signed informed consent was obtained. Sociodemographic and clinical data of interest were then collected. These included information on chronic diseases, medications, ophthalmologic comorbidities (diabetic retinopathy, glaucoma, prior eye surgery, occlusive vascular diseases and congenital disorders), family history of AMD and habits related to the pathology, such as tobacco use. In addition, participants were administered a specific questionnaire to assess health status, Katz Index of Independence in Activities of Daily Living and Hospital Anxiety and Depression (HAD) scale. At the end of the visit, an appointment was made with the eye specialist.

Ophthalmologic examination

All individuals who agreed to see the eye specialist underwent an eye examination consisting of measurement of visual acuity (Snellen scale), anterior segment biomicroscopy with applanation tonometry, fundus observation with 90-dioptre non-contact lens for macular area and indirect binocular ophthalmoscopy and colour fundus retinography. The protocols and equipment used were the same for all participating centres.

Colour fundus retinography was centred on the macular area and carried out under pharmacological mydriasis. In cases of dense lens opacities or the absence of vitreous transparency, the best images obtained were registered. Fundus images were obtained with a non-mydratic TCR-NW6S camera (Topcon Inc., Japan) and IMAGEnet i-base (Topcon Inc., Japan) digital imaging software or a TRC-50IX camera with a Sony 3CCD (Sony Inc., Japan) colour video recorder connected to an IMAGEnet 2000 imaging system (version 2.59; Topcon Inc., Japan). Fluorescein angiography was performed in participants for whom diagnosis was uncertain.

Maculopathy grading

The severity of maculopathy was graded based on the criteria of the International ARM Epidemiological Study Group¹⁵ and classified into five stages, as defined elsewhere.^{16 17} If an individual had eyes with different ARM grades, the worst grade of

Table 1 Characteristics of the study population

Characteristic	Number (%)
Gender	
Male	840 (39.4%)
Female	1292 (60.6%)
Age (years)	
65–69	472 (22.1%)
70–74	506 (23.7%)
75–79	605 (28.4%)
≥80	549 (25.8%)
Smoking status	
Smoker	142 (6.7%)
Ex-smoker	602 (28.2%)
Non-smoker	1388 (65.1%)
Eye colour	
Light coloured	510 (23.9%)
Brown	1622 (76.1%)
Systemic comorbidities*	
Arthritis or rheumatism	1178 (55.5%)
Hypertension	911 (42.7%)
Depression or anxiety	506 (23.7%)
Ischaemic heart disease	446 (20.9%)
Headache	388 (18.2%)
Diabetes	386 (18.1%)
Asthma or chronic bronchitis	269 (12.6%)

*Occurring in >10% of the study population.

severity was recorded. AMD type was classified as atrophic or neovascular using the standard definition of the International ARM Epidemiological Study Group,¹⁵ and participants were classified as having bilateral disease or unilateral disease.

The initial classification and grading were recorded in each of the participating centres. All images were then re-evaluated by an investigator from another participating centre, who was unaware of the initial classification and grading. Discrepancies were reviewed by a panel of four experts from among the study coordinators.

Sample size and statistical analysis

The sample size was calculated in order to estimate the prevalence of AMD with a sampling error of $\pm 1\%$ for the overall population, $\pm 1\%$ for the population aged 65–74 years and $\pm 1.5\%$ for the population aged ≥ 75 years with a 95% confidence level. To guarantee the required reliability, the sample size corresponded to the final valid sample. Although the reliability required for the ≥ 75 age group is lower in absolute terms, the actual reliability is greater in relative terms (coefficient of variation) as a result of the greater expected prevalence (reducing sampling error/expected prevalence). For the stated aim of

Table 2 Ophthalmologic comorbidity associated with age-related maculopathy (ARM) and age-related macular degeneration (AMD)*

	Total	Without		
		ARM	ARM	AMD
Diabetic retinopathy	3.3	3.4	2.8	2.8
Glaucoma	6.5	6.3	8.3	5.6
Congenital degeneration of the retina	0.1	0.1	0.5	–
Ocular tumour	0.2	0.2	0.5	–
Cataracts	36.1	34.9	42.3	46.5
Vascular retinopathies	1.2	1.1	1.4	4.2
Diabetic macular oedema	0.5	0.4	0.1	2.8
Previous cataract surgery/other ocular surgery	29.5	27.4	38.9	54.9

*Data are shown as percentages.

Table 3 Prevalence of age-related maculopathy (ARM) and age-related macular degeneration (AMD) by gender and age*

	Without ARM/AMD Grade 0 (n=1779)	ARM			AMD Grade 4 (n=71)
		Grade 1 (n=165)	Grade 2 (n=44)	Grade 3 (n=8)	
Overall (n=2132)	86.3 (84.5 to 87.9)	7.9 (6.5 to 9.3)	2.0 (1.3 to 2.7)	0.4 (0.1 to 0.7)	3.4 (2.5 to 4.3)
Gender					
Men (n=840)	87.6 (84.9 to 90.3)	7.4 (5.3 to 9.5)	1.1 (1.3 to 3.9)	0.3 (0.0 to 0.7)	3.6 (2.1 to 5.1)
Women (n=1292)	85.1 (82.8 to 87.4)	8.7 (6.9 to 10.5)	2.5 (1.5 to 3.5)	0.4 (0.0 to 0.8)	3.3 (2.1 to 4.5)
Age group					
65–69 years (n=472)	94.0 (91.5 to 96.5)	5.1 (2.7 to 7.5)	0.1 (0.0 to 0.5)	0.1 (0.0 to 0.7)	0.7 (0.0 to 1.6)
70–74 years (n=506)	88.6 (85.3 to 91.9)	7.1 (4.5 to 9.8)	2.4 (0.9 to 4.0)	0.1 (0.0 to 0.4)	1.8 (0.4 to 3.2)
75–79 years (n=605)	86.7 (83.5 to 89.9)	7.9 (5.4 to 10.4)	2.6 (1.1 to 4.1)	0.4 (0.0 to 1.0)	2.4 (0.9 to 3.8)
80 years and older (n=549)	76.0 (71.8 to 80.2)	11.7 (8.5 to 14.9)	3.1 (1.4 to 4.8)	0.7 (0.0 to 1.5)	8.5 (5.7 to 11.3)
65–74 years (n=978)	91.2 (89.1 to 93.3)	6.1 (4.4 to 8.0)	1.3 (0.5 to 2.1)	0.1 (0.0 to 0.3)	1.3 (0.5 to 2.2)
75 years and older (n=1154)	80.9 (78.2 to 83.6)	9.9 (7.9 to 11.9)	2.9 (1.7 to 4.1)	0.6 (0.1 to 1.1)	5.7 (4.1 to 7.3)

Grade 0, absence of any signs of grades 1–3.

Grade 1, soft distinct drusen ($\geq 63 \mu\text{m}$) only or pigmentary abnormalities only (no soft drusen).Grade 2, soft indistinct drusen ($\geq 125 \mu\text{m}$) or reticular drusen only or soft indistinct drusen ($\geq 63 \mu\text{m}$) with pigmentary abnormalities.Grade 3, soft indistinct drusen ($\geq 125 \mu\text{m}$) or reticular drusen only with pigmentary abnormalities.

Grade 4, atrophic or neovascular AMD. In 65 cases, it was not possible to classify the image obtained for at least one eye.

*Data are shown as percentages and 95% CIs.

determining prevalences for the 65–74 age group and the ≥ 75 age group, the sample size of the valid population—excluding non-responders and with non-proportional assignment by age group—was 950 interviews for the 65–74 age group and 1100 interviews for the ≥ 75 age group.

Since the allocation by age group was not proportional, standard weighting factors applied in stratified sampling (by gender and age group, according to the structure of the Spanish population aged ≥ 65 years) were used in estimations of prevalence. Estimates of the prevalence of early ARM and AMD were accompanied by 95% CIs after taking into account the design effect (ratio of the variance with random stratified sampling to that with simple random sampling). Given the estimation procedure and selection method used in the process of sampling according to health district, which guarantees that representative samples are obtained, there was no requirement for analysis of homogeneity upon combining samples from each district. All data were analysed at a single site using SPSS version 13.0 (SPSS Inc., Illinois, USA; 2003) and Stata version 8 (StataCorp LP, Texas, USA; 2003).

RESULTS

Study sample

The characteristics of the study population are shown in table 1. In total, 3028 individuals were contacted and the final valid sample comprised 2132 participants (response rate, 70.4%). The

response rate was very similar in men (70.9%) and women (69.7%) but was higher in participants aged between 65 and 74 years (77.6%) than in those aged ≥ 75 years (65.3%). Non-responders included those who were initially selected but with whom it was impossible to establish contact due to repeated absence, cancelled home visits, etc. (2.7%), those who were successfully contacted but who declined to participate either due to express refusal or inability to attend the centre (6.6%) and those who agreed to participate but did not attend the eye examination on the stipulated day (20.3%). In 65 participants who did attend the eye examination (3.0% of the final valid sample), it was not possible to classify the image in at least one eye. Cataracts were the most common ophthalmologic comorbidity, reported in 36% of the overall sample (table 2). In addition, 30% had undergone prior ocular surgery for cataracts or other conditions. There was no association between either smoking or eye colour and the presence of ARM or AMD (data not shown).

Prevalence of ARM and AMD

Table 3 shows the prevalence of each grade of ARM and AMD by gender and age. The overall prevalence of ARM (grades 1–3) in our study sample was 10.3% (95% CI 8.7% to 11.8%), with a greater prevalence in women (11.6%; 95% CI 9.5% to 13.7%) than men (8.8%; 95% CI 6.5% to 11.1%), although this difference was not statistically significant (age-adjusted prevalence ratio was 1.26 (95% CI 0.93 to 1.70)). The overall prevalence of

Table 4 Prevalence of age-related macular degeneration (AMD) by gender and age*

	AMD				Total (n=71)
	Neovascular (n=38)	Atrophic (n=33)	Unilateral (n=48)	Bilateral (n=23)	
Overall (n=2132)	1.9 (1.1 to 2.6)	1.5 (0.9 to 2.1)	2.3 (1.5 to 3.1)	1.1 (0.6 to 1.6)	3.4 (2.5 to 4.3)
Gender					
Men (n=840)	2.5 (1.2 to 3.7)	1.1 (0.3 to 1.9)	2.6 (1.3 to 3.9)	1.0 (0.2 to 1.8)	3.6 (2.1 to 5.1)
Women (n=1292)	1.4 (0.6 to 2.2)	1.9 (1.0 to 2.8)	2.1 (1.2 to 3.0)	1.2 (0.5 to 1.9)	3.3 (2.1 to 4.5)
Age group					
65–69 years (n=472)	0.5 (0.0 to 1.3)	0.2 (0.0 to 0.7)	0.5 (0.0 to 1.3)	0.2 (0.0 to 0.7)	0.7 (0.0 to 1.6)
70–74 years (n=506)	1.4 (0.2 to 2.6)	0.4 (0.0 to 1.1)	1.5 (0.2 to 2.8)	0.3 (0.0 to 0.9)	1.8 (0.4 to 3.2)
75–79 years (n=605)	0.5 (0.0 to 1.2)	1.9 (0.6 to 3.2)	1.8 (0.6 to 3.1)	0.6 (0.0 to 1.3)	2.4 (0.9 to 3.8)
80 years and older (n=549)	4.4 (2.4 to 6.4)	4.1 (2.1 to 6.1)	5.4 (3.2 to 7.6)	3.1 (1.4 to 4.8)	8.5 (5.7 to 11.3)
65–74 years (n=978)	1.0 (0.3 to 1.7)	0.3 (0.0 to 0.7)	1.0 (0.3 to 1.7)	0.3 (0.0 to 0.7)	1.3 (0.5 to 2.2)
75 years and older (n=1154)	2.7 (1.6 to 3.8)	3.0 (1.8 to 4.2)	3.7 (2.4 to 5.0)	2.0 (1.0 to 3.0)	5.7 (4.1 to 7.3)

*Data are shown as percentages and 95% CIs.

Table 5 Visual acuity impairment associated with age-related maculopathy (ARM) and age-related macular degeneration (AMD)*

	Total	Without ARM	ARM	AMD	ARM/AMD with cataracts (n = 125)	ARM/AMD with previous cataract surgery (n = 123)
>20/40	57.3	59.6	50.6	15.5	37.3	32.2
Mild (20/40–20/80)	22.8	22.6	29.8	7.0	29.8	23.6
Moderate (20/80–20/200)	9.0	8.9	10.7	8.5	8.7	10.7
Severe (20/200–20/400)	5.3	4.8	4.2	22.5	9.0	10.6
Very severe (<20/400)	5.6	4.1	4.7	46.5	15.2	22.9

*Data are shown as percentages.

AMD showed little difference between men and women (age-adjusted prevalence ratio was 0.78 (95% CI 0.48 to 1.27)). The prevalence of both ARM and AMD increased with age, and in both cases there was a marked increase in the population aged at least 80 years.

Neovascular AMD accounted for 54% of cases compared with 46% with the atrophic form (table 4). The neovascular form was more prevalent in men than women (2.5% vs 1.4%). Comparison of the relative proportion of participants with the neovascular and the atrophic form by broad age group revealed a reduction in neovascular AMD (from 76% in the 65–74 years age group to 47% in individuals ≥ 75 years age group), although the trend was less clear when comparing 5-year age intervals (table 4). The prevalence of bilateral disease remained below 1% up to 79 years, but increased to 3.1% (95% CI 1.4% to 4.8%) in the ≥ 80 years age group. This difference between participants ≤ 79 years and those ≥ 80 years was significant ($p < 0.001$).

Visual acuity

Table 5 shows the proportion of participants with impaired visual acuity associated with ARM (grades 1–3) or AMD (grade 4). Approximately half the participants (51%) with ARM had visual acuity $>20/40$ compared with only 16% of those with AMD. Among the participants with AMD, 47% had very severe deterioration in visual acuity (defined as $<20/400$). The proportion of participants with ARM or AMD and at least a mild reduction in visual acuity ($<20/40$) was slightly lower in those with cataracts (62.7%) than in those who had previously undergone cataract surgery (67.8%).

DISCUSSION

The overall prevalence of ARM in our sample of Spanish individuals aged 65 years or older was 10.3%, while the prevalence of AMD was 3.4%. According to official census data for the Spanish population, there are approximately 7.5 million individuals aged 65 years or more (Municipal Register of Inhabitants, 2007;

Spanish National Institute of Statistics; <http://www.ine.es/>). The results of our study therefore suggest that, in Spain, approximately 255 000 individuals have AMD, while 773 000 individuals have ARM and so are at risk of progressing to AMD.¹⁸ Given the substantial impact of the associated vision loss on quality of life,³ this represents a heavy societal burden.¹⁹ Although formal modelling would be required to provide an accurate prediction of the trends in prevalence of these conditions, taking into account the influx of younger immigrants, the availability of treatments²⁰ and the possible use of antioxidant therapy to slow early disease progression,²¹ it seems likely that this burden will only increase as the population ages.

The prevalence of AMD observed in this study was similar to that observed in other studies with comparable age ranges (table 6). Interestingly, the prevalence for individuals ≥ 65 years in our study was similar to the overall prevalence for that age group in the European Eye Study (EUREYE), but higher than the prevalence of 1.34% observed when considering only the participants included at the Spanish centre. Although it may be tempting to speculate that this difference reflects regional differences in the prevalence of AMD within Spain, care must be taken not to over interpret the findings of the two studies. Our study included a substantially larger number of Spanish participants over a much wider geographic area as it was designed to provide a reliable estimate of the prevalence throughout Spain. However, it was not designed to assess regional differences and further studies involving careful control of the multiple genetic, lifestyle-related and climatic factors that could be proposed to explain putative differences in prevalence would be required in order to address this question.

Our study benefitted from a number of measures to increase participation, including initial telephone contact and subsequent follow-up, and this may account for the higher response rate than in studies where such measures were not possible.¹² Nevertheless, despite the high response rate and the strictly random selection of participants based on census data,

Table 6 Comparative prevalences of age-related macular degeneration (AMD) in different population-based studies*

Study	Age, years					
	60	65	70	75	80	85
Beaver Dam Eye Study, 1992 (Australia) ¹⁴	-		1.4% (65–74 y)		7.1% (≥ 75 y)	
Rotterdam Study, 1995 (Netherlands) ²⁵	-		0.8% (65–74 y)		3.7% (75–84 y)	11.0% (≥ 85 y)
Blue Mountains Eye Study, 1995 (Australia) ²⁶	-		0.7% (65–74 y)		5.4% (75–84 y)	18.5% (≥ 85 y)
Los Angeles Latino Eye Study, 2004 (California) ²⁷	0.3% (60–69 y)		1.5% (70–79 y)		8.5% (≥ 80 y)	
Proyecto VER, 2005 (Arizona) ²⁸	0.5% (60–69 y)		0.8% (70–79 y)		4.3% (≥ 80 y)	
European Eye Study (EUREYE), 2006 ¹²	-		3.3% (≥ 65 y)			
Spanish Eyes Epidemiological Study Group (Spain)	-		1.3% (65–74 y)		5.7% (≥ 75 y)	

*Corresponding age ranges are shown in parentheses.

Table 7 Comparative prevalences of age-related maculopathy (ARM) by individual grade*

Study	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Spanish Eyes Epidemiological (SEE) Study Group (Spain)†	86.3 (84.5 to 87.9)	7.9 (6.5 to 9.3)	2.0 (1.3 to 2.7)	0.4 (0.1 to 0.7)	3.4 (2.5 to 4.3)
European Eye Study (EUREYE) ¹² †	47.6 (43.5 to 51.7)	36.5 (32.7 to 40.3)	10.1 (8.9 to 11.4)	2.5 (1.8 to 3.1)	3.3 (2.5 to 4.1)
INDEYE Study ²⁶ ‡		39.5 (37.4 to 41.6)	6.7 (5.9 to 7.6)	0.3 (0.1 to 0.4)	1.2 (0.9 to 1.6)

Grade 0, absence of any signs of grades 1 to 3.

Grade 1, soft distinct drusen ($\geq 63 \mu\text{m}$) only or pigmentary abnormalities only (no soft drusen).

Grade 2, soft indistinct drusen ($\geq 125 \mu\text{m}$) or reticular drusen only or soft indistinct drusen ($\geq 63 \mu\text{m}$) with pigmentary abnormalities.

Grade 3, soft indistinct drusen ($\geq 125 \mu\text{m}$) or reticular drusen only with pigmentary abnormalities.

Grade 4, atrophic or neovascular age-related macular degeneration (AMD).

*Values are expressed as percentage (95% CI).

†Participants aged ≥ 65 years.

‡Participants aged ≥ 60 years.

individuals who perceived themselves as having poorer vision may have been more likely to attend, thus introducing a potential source of bias. We also note that the study period coincided with a certain degree of expectation about new treatments such as intravitreal anti-angiogenics, which might have encouraged a larger proportion of individuals with AMD to participate.

Although the prevalence of AMD observed in our study was similar to that found in other populations, estimates for the overall prevalence of ARM (10.3% for grades 1–3) appear to be markedly lower than that might be expected based on previous studies. To facilitate comparison, table 7 compares the prevalences obtained for each grade in our study with those reported in the EUREYE¹² and INDEYE²⁶ studies, which used similar classifications. This comparison shows that the greatest differences lie in the prevalence of grades 1 and 2 ARM (and consequently grade 0). The reasons for these differences are not immediately apparent and merit further investigation. However, our observation that the prevalence of AMD was similar in our sample to that reported for other populations may suggest that earlier grades of ARM are not always accurate indicators of progression to AMD, as has been suggested previously.²⁷ It should also be noted that, in our study, grading was initially performed in each participating centre, as this may have resulted in differences compared with studies in which all images were centrally graded.

For individuals with AMD, 69% had severe (Snellen equivalent 20/200–20/400) or very severe ($<20/400$) deterioration in visual acuity. This figure is lower than that reported in the population-based Blue Mountains Eye Study, in which ARM degeneration was cited as the cause of severe or very severe deterioration in visual acuity in 21/44 (87.5%).²⁸ Interestingly, in our study, the effect of ARM/AMD on visual acuity could not be explained by the presence of cataracts, since the proportion of individuals with ARM/AMD and reduced visual acuity was similar or lower in individuals with cataracts compared with those who had undergone cataract surgery.

In conclusion, this is the first epidemiological study of the prevalence of ARM and AMD in Spain using a multicentre design with standardised methodology. The prevalences observed for AMD were similar to those obtained for a variety of other populations, although considerably higher than the prevalence reported for the Spanish centre included in the EUREYE study,¹² the only other population-based study of ARM and AMD to include Spanish participants. By contrast, the prevalence of ARM was considerably lower than reported for other populations. Future studies should explore the progression of ARM to AMD in the Spanish population and analyse possible regional differences in the prevalence of AMD.

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Competing interests Isabel Fernández-Arias and Hae Kyung Kim work for Pfizer S.A.

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APPENDIX 1

Spanish eyes epidemiological (SEE) study group

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