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Association of Rhegmatogenous Retinal Detachment Incidence With Myopia Prevalence in the Netherlands

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Invited Commentary

Supplemental content

IMPORTANCE The incidence of rhegmatogenous retinal detachment (RRD) is partly determined by its risk factors, such as age, sex, cataract surgery, and myopia. Changes in the prevalence of these risk factors could change RRD incidence in the population.

OBJECTIVE To determine whether the incidence of RRD in the Netherlands has changed over recent years and whether this change is associated with an altered prevalence of RRD risk factors.

DESIGN, SETTING, AND PARTICIPANTS This cohort study included data from all 14 vitreoretinal clinics in the Netherlands, as well as a large Dutch population-based cohort study. All patients who underwent surgical repair for a primary RRD in the Netherlands from January 1 to December 31, 2009, and January 1 to December 31, 2016, were analyzed, in addition to all participants in the population-based Rotterdam Study who were examined during these years. Analysis began February 2018 and ended November 2019.

EXPOSURES RRD risk factors, including age, male sex, cataract extraction, and myopia.

MAIN OUTCOMES AND MEASURES Age-specific RRD incidence rate in the Dutch population, as well as change in RRD incidence and risk factor prevalence between 2009 and 2016.

RESULTS In 2016, 4447 persons (median [range] age, 61 [3-96] years) underwent surgery for a primary RRD within the Netherlands, resulting in an RRD incidence rate of 26.2 per 100 000 person-years (95% CI, 25.4-27.0). The overall RRD incidence rate had increased by 44% compared with similar data from 2009. The increase was observed in both phakic (1994 in 2009 to 2778 in 2016 [increase, 39%]) and pseudophakic eyes (1004 in 2009 to 1666 in 2016 [increase, 66%]), suggesting that cataract extraction could not solely account for the overall rise. Over the same period, the prevalence of mild, moderate, and severe myopia among persons aged 55 to 75 years had increased by 15.6% (881 of 4561 [19.3%] vs 826 of 3698 [22.3%]), 20.3% (440 of 4561 [9.6%] vs 429 of 3698 [11.6%]), and 26.9% (104 of 4561 [2.3%] vs 107 of 3698 [2.9%]), respectively, within the population-based Rotterdam Study.

CONCLUSIONS AND RELEVANCE In this study, an increase was observed in primary RRD incidence in the Netherlands over a 7-year period, which could not be explained by a different age distribution or cataract surgical rate. A simultaneous myopic shift in the Dutch population may be associated, warranting further population-based studies on RRD incidence and myopia prevalence.

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A rhegmatogenous retinal detachment (RRD) is one of the most common sight-threatening emergencies in the Western world. An RRD develops from retinal breaks occurring at points of firm vitreoretinal adhesion and dynamic traction on the retina, eg, during posterior vitreous detachment.[1] Even with timely surgery, an RRD may result in severe visual impairment.[2] The incidence of RRD has been studied in many populations around the world.[3] The earliest published figures come from admission data from English national hospital statistics.[4] Later, population-based studies were performed in numerous regions, cities, and countries all around the world. During the 1970s, the annual incidence of RRD ranged from 6.9 to 11.0 cases per 100 000 persons and increased to 8.0 to 17.9 cases per 100 000 in the 1990s and early 2000.[5-8] Recent studies from Denmark and the Netherlands reported even higher incidence rates of 22.0 and 18.2 cases per 100 000, respectively.[9-11] This variability in RRD incidence may be explained by differences in study design, definitions, and the prevalence of risk factors, such as age, male sex, cataract extraction, and myopia.[3,12,13]

The purpose of the present study was to determine the incidence rate of RRD in the Netherlands in 2016 and compare this with the incidence found in our 2009 study.[10] In addition, we studied trends in RRD risk factors in the Dutch population over the same period.

Key Points

Question What is the incidence of primary rhegmatogenous retinal detachment (RRD) in the Netherlands and has it changed over recent years?

Findings In this cohort study, 4447 individuals in the Netherlands underwent surgery for RRD in 2016, resulting in an incidence of 26.2 per 100 000 inhabitants, an increase of 44% compared with similar data from 2009. Over the same period, an increase in myopia prevalence in a Dutch population-based cohort study was observed.

Meaning In the Netherlands, an increase in RRD incidence may be associated with a simultaneous myopic shift in the population.

Methods

Study Population

The incidence rate of RRD was studied within the total population of the Netherlands. In the Netherlands, all patients diagnosed with RRD are referred to 1 of 14 vitreoretinal centers. All 14 centers participated in this collaborative study as the Dutch RRD Study Group. The institutional review board of the University Medical Centre Utrecht waived the need for medical ethical approval in all centers, and patient consent was also waived. The study adhered to the tenets of the Declaration of Helsinki[14] and its later amendments. Information on the magnitude of the Dutch population was obtained from Statistics Netherlands, the Dutch national office for statistics.

To determine a possible change in the prevalence of myopia, we analyzed data from the prospective population-based Rotterdam Study.[13] The Rotterdam Study is one of the largest cohort studies in the Netherlands and has included all inhabitants 45 years and older of a well-defined district in Rotterdam, the Netherlands. The high response rate (72.0%) and large study size (n = 14 926) make this cohort representative for the middle-aged and elderly population of the Netherlands.

Data Collection

All cases with primary RRD undergoing surgery from January 1, 2016, through January 1, 2017, were retrospectively collected. Surgery for RRD included conventional surgery, pars plana vitrectomy, and pneumatic retinopexy. Cases with laser retinopexy solely were not included. RRD was defined as a retinal detachment with a retinal break, detected before or during surgery. Tractional, exudative, and traumatic retinal detachments were excluded, as was any prior retinal detachment in the same eye. Therefore, reoperations for retinal detachment were not included.

Data were extracted from surgical reports and included the patient's age, sex, and affected eye; macula-off or macula-on detachment; date of RRD surgery; and history of cataract extraction. Macula-off RRD was defined as a foveal detachment before or at the time of surgery or a visual acuity of less than 20/40 that could not be explained by other stated pathologic features, such as media opacities, amblyopia, or macular or optic nerve pathologic characteristics.

Participants of the Rotterdam Study underwent an extensive ophthalmological examination (eTable in the Supplement).[13] Relevant to this study, noncycloplegic refraction was initially obtained after objective autorefraction (Topcon RM-A2000 Autorefractor; Topcon Optical Company) and then subjectively adjusted. We defined myopia categories according to the recent classification introduced by the International Myopia Institute: low myopia (spherical equivalent, −0.5 diopter [D] to −3 D), moderate myopia (spherical equivalent, −3 D to −6 D), and high myopia (spherical equivalent, ≤−6 D).[15]

Statistical Analyses

The incidence rate was calculated by dividing the number of new RRD cases in 2016 by the population size on January 1, 2016, and defined as cases per 100 000 person-years. This was done for the total population and for each 5-year age category. Bilateral cases were counted only once. A 95% CI of the annual incidence was calculated based on the Poisson distribution. *t* Tests and χ^2 tests were used to examine differences between 2 groups. Two-sided *P* values were significant at less than .05, and adjustments to *P* values for multiple analyses were not made. Data were collected and analyzed using Microsoft Office Excel version 14.0 (Microsoft) and IBM SPSS Statistics version 25 (IBM).

To estimate a possible change in myopia prevalence, we compared within the Rotterdam Study the proportion of myopia categories in persons aged 55 to 90 years in 2009 with the same age category in 2016. For this purpose, we calculated the age of all participants in 2009 and 2016 to assess eligibility in the cohort and calculated age-specific percentages

Table. Number of Individuals and Incidence Rate of Primary Rhegmatogenous Retinal Detachment (RRD) in the Netherlands

Age category, y	No. (%)			All cases with RRD		Male individuals with RRD		Female individuals with RRD		Male:female ratio
	Total	Male	Female	No.	Incidence rate[a]	No.	Incidence rate[a]	No.	Incidence rate[a]	
<5	876 854	449 312 (51.2)	427 542 (48.8)	2	0.23	1	0.22	1	0.23	1.0:1
5-9	930 038	476 011 (51.2)	454 027 (48.8)	9	0.97	5	1.05	4	0.88	1.2:1
10-14	992 880	507 764 (51.1)	485 116 (48.9)	13	1.31	12	2.36	1	0.21	1.5:1
15-19	1 018 727	521 725 (51.2)	497 002 (48.8)	35	3.44	21	4.03	14	2.82	1.4:1
20-24	1 065 946	541 020 (50.8)	524 926 (49.2)	33	3.10	21	3.88	12	2.29	1.7:1
25-29	1 071 002	540 790 (50.5)	530 212 (49.5)	39	3.64	21	3.88	18	3.39	1.1:1
30-34	1 017 341	511 331 (50.3)	506 010 (49.7)	62	6.09	36	7.04	26	5.14	1.4:1
35-39	1 009 413	504 350 (50.0)	505 063 (50.0)	69	6.84	44	8.72	25	4.95	1.8:1
40-44	1 119 982	557 618 (49.8)	562 364 (50.2)	137	12.23	84	15.06	53	9.42	1.6:1
45-49	1 286 744	646 349 (50.2)	640 395 (49.8)	342	26.58	236	36.51	106	16.55	2.2:1
50-54	1 280 519	643 844 (50.3)	636 675 (49.7)	589	46.00	393	61.04	196	30.78	2.0:1
55-59	1 170 614	585 735 (50.0)	584 879 (50.0)	892	76.20	602	102.78	290	49.58	2.1:1
60-64	1 053 752	525 615 (49.9)	528 137 (50.1)	829	78.67	576	109.59	253	47.90	2.3:1
65-69	1 046 703	519 227 (49.6)	527 476 (50.4)	664	63.44	454	87.44	210	39.81	2.2:1
70-74	729 512	353 646 (48.5)	375 866 (51.5)	342	46.88	225	63.62	117	31.13	2.0:1
75-79	560 345	257 171 (45.9)	303 174 (54.1)	222	39.62	138	53.66	84	27.71	1.9:1
80-84	394 936	163 046 (41.3)	231 890 (58.7)	115	29.12	76	46.61	39	16.82	2.8:1
85-89	234 300	81 748 (34.9)	152 552 (65.1)	39	16.65	21	25.69	18	11.80	2.2:1
90-94	96 978	26 376 (27.2)	70 602 (72.8)	11	11.34	5	18.96	6	8.50	2.2:1
≥95	22 534	4457 (19.8)	18 077 (80.2)	3	13.31	2	44.87	1	5.53	8.1:1
Total	16 979 120	8 417 135 (49.6)	8 561 985 (50.4)	4447	26.19	2973	35.32	1474	17.22	2.1:1

[a] Per 100 000 person-years.

of myopia categories in both years. Next, we calculated the relative change in prevalence of myopia by dividing the difference in myopia prevalence between 2009 and 2016 by the prevalence in 2009. Only persons alive at December 31, 2009, and December 31, 2016, were eligible for the prevalence estimation in 2009 and 2016, respectively. Analysis began February 2018 and ended November 2019.

Results

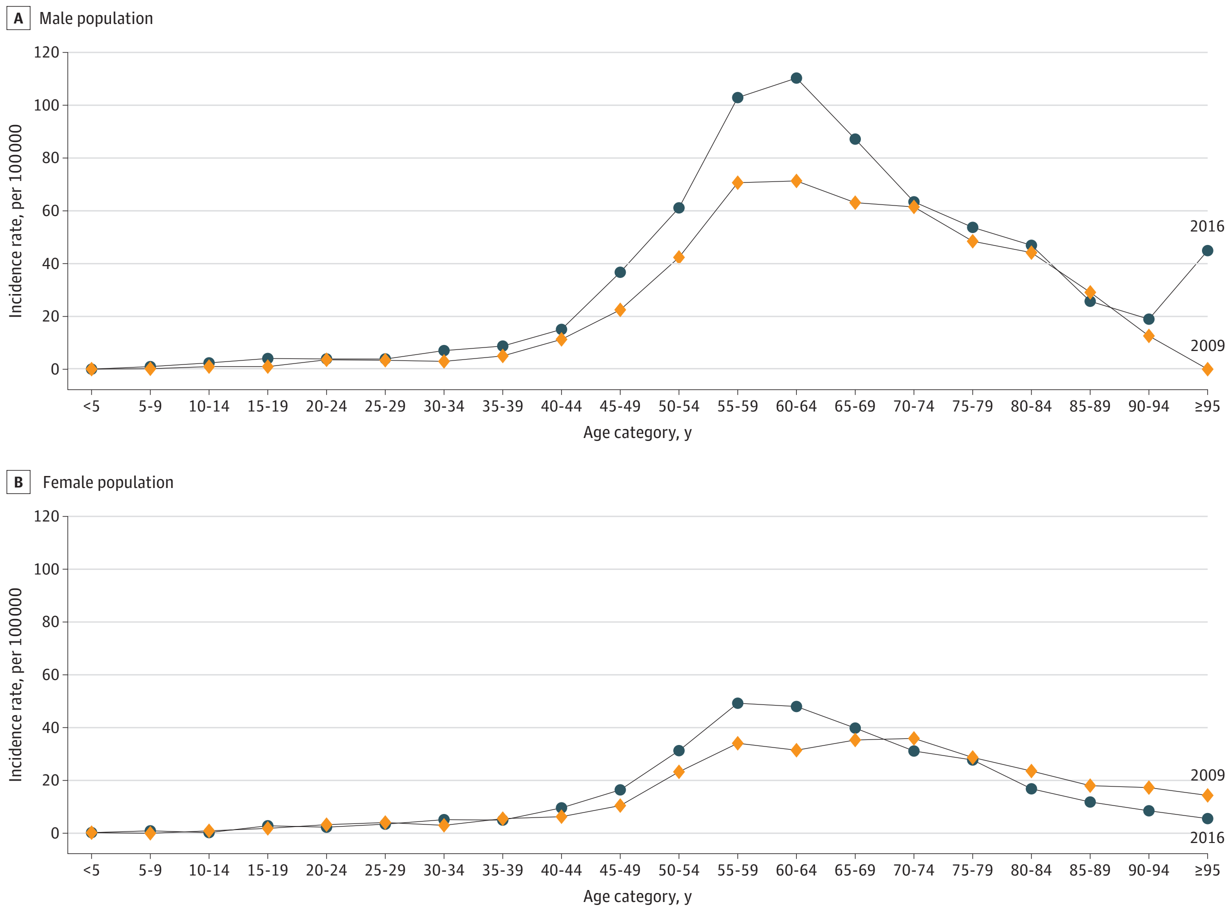
On January 1, 2016, the population of the Netherlands consisted of 16 979 120 inhabitants. Within this population, 4447 persons with a primary RRD underwent vitreoretinal surgery in 2016. This number results in an annual incidence rate of 26.2 per 100 000 person-years (95% CI, 25.4-27.0). Of these cases, 36 persons (0.8%) developed bilateral primary RRD within the same year.

The median (range) age of patients with RRD was 61 (3-96) years. Distribution of the incidence rate over the age categories is presented in the **Table**. The incidence rate increased considerably after age 50 years and decreased after age 75 years. Incidence rate was highest in the age categories 55 to 59 years (76.2 per 100 000 person-years) and 60 to 64 years (78.7 per 100 000 person-years). Of 4447 cases, 2975 (66.9%) were male and 1472 (33.1%) were female, giving an overall male:female ratio of 2.1:1. This ratio increased from on average 1.4:1 in the age categories between 5 and 45 years to 2.2:1 in the age categories between 45 and 95 years (<5 years and ≥95 years were excluded because of low numbers). The median (range) age at RRD incidence was similar in male individuals (61 [6-96] years) and female individuals (60 [3-96] years) (95% CI, 0.99-1.00; $P = .72$). In 2321 cases (52.2%), the right eye was affected. The macula was detached at the time of surgery in 2403 patients (54.0%). This percentage was higher for male individuals (1648 [55.4%]) than for female individuals (755 [51.2%]) (95% CI, 1.05-1.35; $P = .04$).

Of 4447 patients with RRD, 2778 (62.5%) had phakia, 21 (0.5%) had aphakia, and 1645 (37%) had a history of cataract extraction with intraocular lens implantation (pseudophakia). The median (range) age of patients with RRD and phakia (58 [3-96] years) was lower than the median (range) age of patients with aphakia and pseudophakia (65 [8-96] years) (95% CI, 1.05-1.07; $P < .001$). Because we did not have data on the exact prevalence of pseudophakia in the Netherlands in 2016, we were not able to calculate the incidence of RRD for patients with pseudophakia separately.

As reported in our previous study, 2998 patients with a primary RRD had undergone surgery in 2009, resulting in an overall annual incidence rate of 18.2 per 100 000 inhabitants.[10] In 2016, the Dutch population had increased by 3% compared with the 16 485 787 inhabitants on January 1, 2009. Compared with the incidence in 2009, the overall annual incidence rate in 2016 had increased by 44%. In **Figure 1**, the age-specific incidence rates of male and female individuals in 2009 and 2016 are shown. The increase in overall incidence was most pronounced in the age categories of 50 to 70 years. The overall incidence rates in male individuals had increased by 52%

Figure 1. Age-Specific Incidence Rate of Primary Rhegmatogenous Retinal Detachment



(35.3 per 100 000 vs 23.3 per 100 000) and in female individuals by 30% (17.2 per 100 000 vs 13.2 per 100 000). The proportion of macula-off detachment in 2016 (2403 of 4447 [54.0%]) was similar to the 54.5% (1633 of 2998) observed in 2009.

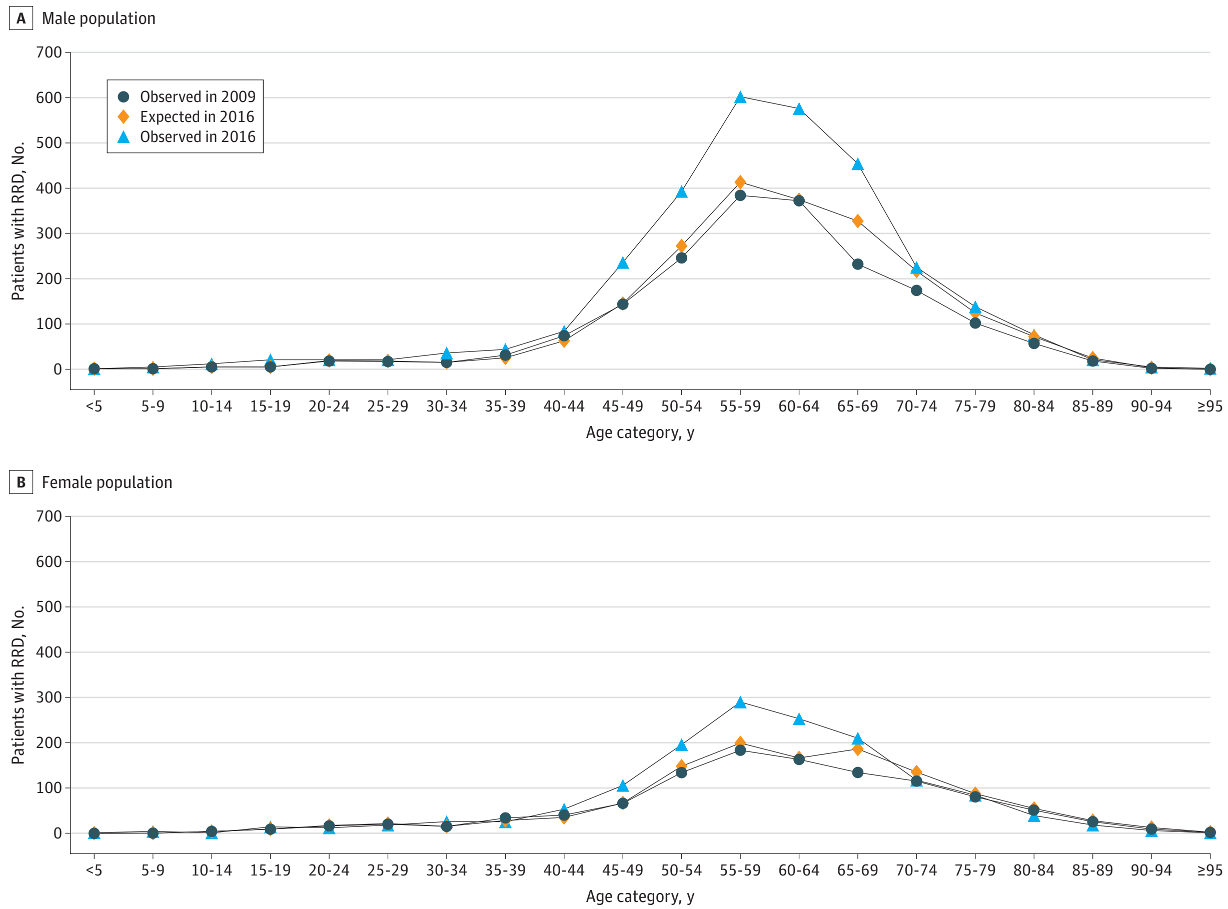
To confirm the finding of an increased overall incidence, we looked at the numbers at each vitreoretinal center separately. The total number of centers in the Netherlands decreased from 15 in 2009 to 14 in 2016. In almost all centers, the number of patients with RRD had increased, ranging from 5% (788 vs 754) to 734% (267 vs 32) (eFigure 1 in Supplement). In some regions of the Netherlands, the variation in number could be explained by external factors. Some small centers stopped performing vitreoretinal surgery (Zwolle and Tiel), some centers started a merger with redistribution of patients (Amsterdam), and a newly established vitreoretinal center accounted for the increase in patients with RRD within the same region (Den Haag and Rotterdam).

Because age is an important risk factor for RRD, we examined whether a different age distribution could explain the increased RRD incidence.[3] Based on the age-specific incidence rates of 2009 and the age distribution of the Dutch population in 2016, we calculated the expected number of incident RRD cases in 2016. These expected numbers were not very different from the observed numbers in 2009 and were much lower than the observed numbers in 2016 (**Figure 2**). Moreover, the median age of patients with RRD in 2016 (61 years) was similar to the median age of 60 years observed in 2009.

The increase in RRD incidence was observed in phakic eyes and pseudophakic eyes, suggesting that cataract extractions cannot account for the rise in overall RRD incidence (**Figure 3**). The total number of phakic RRDs increased from 1994 in 2009 to 2778 in 2016 (increase, 39%). The total number of pseudophakic RRDs increased from 1004 in 2009 to 1666 in 2016 (increase, 66%). The overall ratio of phakic to pseudophakic RRD changed from 2.0 in 2009 to 1.7 in 2016.

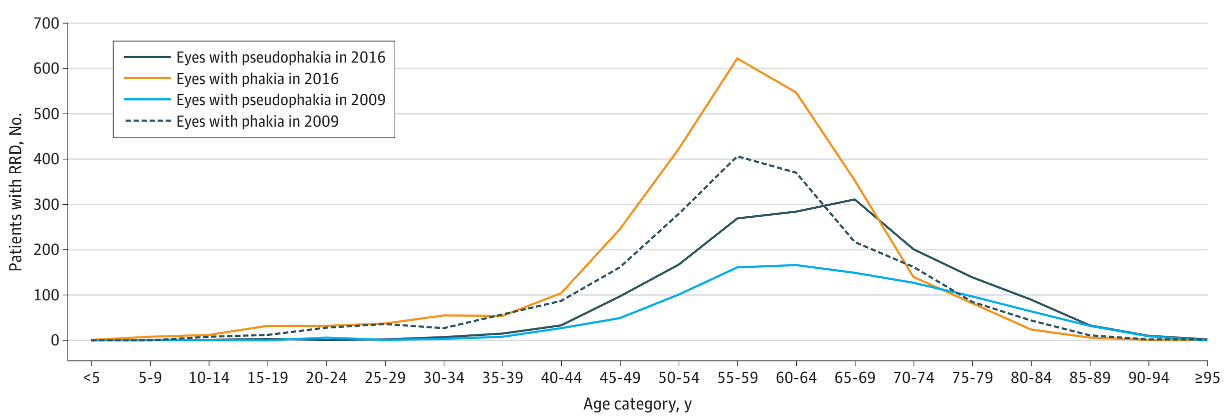
To investigate a possible increase in myopia prevalence in the Dutch population between 2009 and 2016, we used data from the Rotterdam Study. Indeed, in every age category from 55 to 75 years, the proportion of persons with myopia increased (**Figure 4**). The proportion of persons with low myopia increased from 19.3% (881 of 4561) to 22.3% (826 of 3698) (relative increase, 15.6%), with moderate myopia from 9.6% (440 of 4561) to 11.6% (429 of 3698) (relative increase, 20.3%) and with high myopia from 2.3% (104 of 4561) to 2.9% (107 of 3698) (relative increase, 26.9%). At the same time, the proportion of people with emmetropia and hyperopia decreased from 68.8% (3136 of 4561) to 63.2% (2336 of 3698) (relative decrease, 8.1%). We also looked for a sex difference in myopia prevalence. The proportion of low

Figure 2. Expected and Observed Number of Patients With a Primary Rhegmatogenous Retinal Detachment (RRD)



The expected numbers in 2016 are based on the age-specific incidence rate in 2009 and the population in 2016.

Figure 3. Age-Specific Number of Patients With a Primary Rhegmatogenous Retinal Detachment (RRD) Broken Down for Lens Status

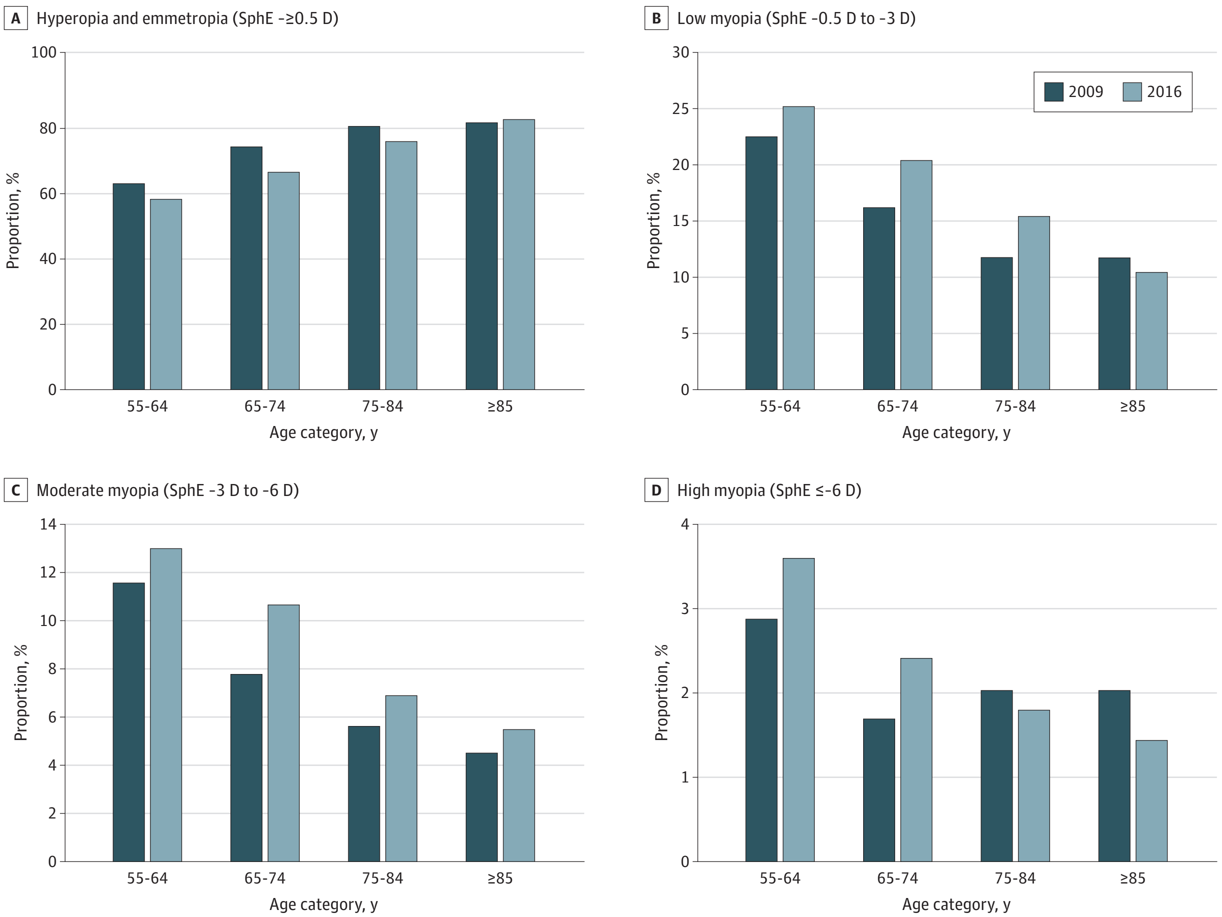


myopia in 2009 was 18.3% (572 of 3131) in male individuals vs 14.8% (679 of 4580) in female individuals (χ^2 = 15.3; P < .001). In 2016, these numbers were 20.6% (568 of 2760) in male individuals vs 16.8% (683 of 4054) in female individuals (χ^2 = 16.2; P < .001). Data for all myopia categories broken down by sex are presented in eFigure 2 in Supplement.

Discussion

The current study is an exact repeat of the study in 2009 with similar design, similar case ascertainment, and similar target population. All vitreoretinal surgeons in the Netherlands pro-

Figure 4. Age-Specific Proportion of Participants With Myopia Categories in the Rotterdam Study in 2009 and 2016



D indicates diopter; SphE, spherical equivalent.

vided data, using the same definitions and the same inclusion and exclusion criteria. The population of the Netherlands is well defined and rather stable over time in terms of migration. In 2016, the migration balance was 79 194 persons or 0.47%.[16] Moreover, a collective health insurance system, obligatory for all legal residents in the Netherlands, allows for unrestricted access to health care. This minimizes the chance of missed RRD cases. In the relevant period, referral, diagnosis, or management of patients with RRD did not change, apart from the introduction of an ultra-widefield camera in one of the 14 vitreoretinal centers. Patients with a primary RRD who did not undergo surgery for whatever reason were not included. We think that this concerns a negligible number of patients.

In line with the literature, the highest RRD incidence was observed in the age group of 55 to 65 years. We did not observe a bimodal age distribution as described in some studies from Asian countries.[17,18] It has been suggested that the early incidence peak results from patients with high myopia who develop an RRD at a young age.[18] We do not know whether such a group of young persons with high myopia also exists in the Netherlands because the Rotterdam Study only included persons 55 years and older. Moreover, refractive error was not measured in these patients with RRD. Both Chen et al[18] and Li et al[19] suggested that the mean and median age of patients with RRD is lower in Asian countries compared with Western countries. Indeed, the median age of patients with phakic RRD in China was 53 years and in Taiwan was 50 years.[18,19] The median age of all patients with RRD in Korea was 53 years.[17] In contrast to this, the mean age of patients with RRD in Sweden was 60.2 years and in Denmark was 61.8 years.[9,20] The median age in the present Dutch study was 58 years. These few numbers suggest that in Asia, phakic RRD occurs at an earlier age, and the peak incidence at older age is lower compared with European populations. Unfortunately, many incidence studies did not provide mean or median age of patients with phakic RRD.

We examined different possible explanations for the increased RRD incidence rate in the Netherlands, considering the established risk factors for RRD. A relative increase in the number of persons within the high-risk age category of 55 to 75 years could be ruled out by calculating the expected number of RRD cases based on the 2009 age-specific incidence rates. Also, the proportion of male individuals in the Dutch population did not increase in 2016 compared with 2009.[16] Unfortunately, we could not ascertain the exact number of cataract extractions in 2009 and 2016 in the Netherlands because no reliable national cataract surgery data were available for these particular years. Information on cataract extractions in the years before the RRD occurred may be more relevant. Data from the Dutch national office for statistics showed an increase in cataract surgical rate of 55.9 per 10 000 persons in 2000 to 88.5 per 10 000 persons in 2009.[16] This increase may in part explain the rise in pseudophakic RRD incidence, but it cannot explain the increased incidence in phakic eyes.

An increase in myopia prevalence may be an alternative explanation for the rise in incident RRD cases after 2009. We used data from a large population-based cohort study to examine a possible change in refraction of the Dutch population. Indeed, we found a myopic shift in persons aged 55 to 75 years in all myopia categories between 2009 and 2016. This coincidence does not prove a causal relationship. However, as discussed previously, other explanations have been examined and deemed unlikely. More studies in other countries are needed to confirm our findings and hypothesis. The link between myopia and RRD may involve a posterior vitreous detachment. Myopic eyes experience a posterior vitreous detachment at an earlier age and with a higher risk of retinal breaks.[21,22] The latter may be explained by a thinner retina, both in the equatorial and pre-equatorial region, with myopic axial globe elongation.[23] Previous studies have reported on the refractive error of patients with RRD in a case-control design.[3,24] Recently, observational analyses and 2-sample mendelian randomization within a cohort of European descent also demonstrated that myopia is associated with RRD risk.[13] However, as far as we know, no study has presented data on the absolute risk of RRD for myopia categories.

An increase in RRD incidence has been reported before. Historical data from England showed a stable admission rate for retinal detachment surgery between 1963 and 2000 and an increased rate between 2000 and 2011, with a maximum incidence rate of 15.4 per 100 000.[4] However, this study included all types of retinal detachment and concluded that the increased incidence rate was probably attributable to an increase in diabetes prevalence. In Scotland, an increased age-standardized annual RRD incidence rate was observed between 1987 and 2006.[3,25] This rise in RRD incidence was more notable in male individuals of all ages with a trend toward earlier age of onset. In Denmark, the age- and sex-standardized RRD incidence rate had increased between 2000 and 2011 by a statistically significant 0.1 per 100 000 per year.[26] The number of nonphakic RRD cases doubled in this period, but this subgroup accounted for only 20% of cases and could not explain the total increase in RRD incidence according to the authors. Chen et al[18] did not observe a change in age-standardized incidence rate of RRD from 2000 to 2012 in Taiwan. A large nationwide population-based study in Korea reported an incidence rate of 10.4 RRD cases per 100 000 person-years, which did not change over a 5-year period.[17] A population-based study in West Australia found a 47% increase in annual number of RRD cases over a 13-year period, which could be explained by population demographic changes.[27] The differences between RRD incidence rates in the literature may be explained by differences in study design, measurement or sampling errors, or real differences between populations. If there is a link between rising myopia prevalence and RRD incidence, future studies in different populations should point in the same direction.

A shift to more myopia in recent birth cohorts has been reported before in different parts of the world.[28-31] The trend observed in the Rotterdam Study fits in a global pattern, although this study cohort represents only the population older than 55 years. The myopic shift among younger age groups will be stronger. Consequently, the increase in RRD incidence in the Netherlands may be even larger in the future, which should alert policy makers in future health care planning.[32]

Limitations

A potential drawback of the current study is the limited 1-year time period of data collection. A 5-year follow-up study would have been even more robust. Unfortunately, data on the refraction or axial length of the incident RRD cases was not available. Future studies on RRD incidence should include this risk factor in the case description.

Conclusions

In conclusion, the incidence of a primary RRD in the Netherlands has increased between 2009 and 2016. Demography and cataract extractions could only partly account for this observation. Over the same period, a myopic shift was observed in the Dutch population, which may be linked to the higher RRD incidence rate. Future studies should confirm this trend in RRD incidence.

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Drafting of the manuscript: van Leeuwen, Haarman.
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