Chapter 3

The incidence of rhegmatogenous retinal detachment in The Netherlands

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ABSTRACT

Purpose: To estimate the incidence and characteristics of rhegmatogenous retinal detachment (RRD) in the Netherlands in 2009.

Methods: By reviewing surgical logs cases of primary RRD repair in 2009 were identified. Exclusion criteria included RRD prior to 2009, exudative, tractional, or traumatic retinal detachments. Patient demographics, date of surgery and lens status were documented. RRD incidence and 95% confidence intervals (CI) were calculated. Age distribution, male-to-female ratio, and proportion of RRD patients with prior cataract extraction (CE) were determined. A Student's t-test was used to examine differences in the incidence of RRD between groups.

Results: The annual RRD incidence was 18.2/100,000 people (95% confidence interval [CI] = 11.4 - 18.8) with a peak incidence of 52.5/100,000 people (95% confidence interval [CI] = 29.4 - 56.8) between 55-59 years of age. Bilateral RRD rate was 1.67%. Macula-off presentation occurred in 54.5% of all RRD patients. Prior CE was noted in 33.5% of RRD eyes. The male-to-female ratio was 1.3:1, and RRD incidence was statistically significantly more frequent in males (P < 0.0001).

Conclusions: Rhegmatogenous retinal detachment is predominantly a disease of the population over 50 years of age, and males are more susceptible to RRD. The annual RRD incidence is highly dependent on demographic characteristics.

INTRODUCTION

Rhegmatogenous retinal detachment (RRD), which refers to a separation of the neurosensory retina from the underlying retinal pigment epithelium due to a defect in the retina, is a potentially blinding ophthalmic pathology.[1] Despite advances in treatment, functional results remain poor, with only 42% of all RRD eyes achieving ≥ 20/40 vision, and only 37% achieving ≥ 20/50 in macula-off detachments.[2,3]

In Western populations (e.g., Europe, United States, Australia), the annual incidence of rhegmatogenous retinal detachment (RRD) was 6.1-9.8 cases per 100,000 people during the 1970s, increasing to 11.8-17.9 cases per 100,000 people in the 1990s.[4-12] A recent study reported an incidence of 12.05 cases per 100,000 people at the beginning of the twenty-first century in a relatively young population,[11] whereas another study in the Netherlands found an incidence of 17.42/100,000 people per year in a relatively older population.[13]

The broad variety in RRD incidence rates over the past forty years may be explained by the pathophysiology of RRD. Because of a complicated posterior vitreous detachment (PVD),[14] and to a lesser extent as a late consequence of a previous cataract extraction (CE),[15] RRD occurs predominantly at an advancing age.[4-12] Consequently, the RRD incidence is higher in relatively older populations,[13], and lower in relatively younger populations.[11]

The purpose of this study was to estimate the incidence and describe the characteristics of RRD in the Netherlands in 2009.

METHODS

Study population

The population of the Netherlands, based on the 2009 census, was approximately 16,485,787.[16] To be included in this study as an RRD case, the patient must have been a permanent resident of the Netherlands in 2009. All Dutch RRD patients are operated on in one of sixteen centers with a capacity for vitreoretinal surgery, and all sixteen centers participated in this collaborative study as the "Dutch RRD Study Group." The internal review board (IRB) of the University Medical Center Groningen waived the need for IRB approval in all centers. The study has adhered to the tenets of the Declaration of Helsinki.

Data collection

Data were collected retrospectively. All cases of primary RRD operated on from January 1, 2009, until January 1, 2010, were identified using the surgical logs. Surgery for RRD was defined as conventional surgery, trans pars plana vitrectomy, and pneumatic retinopexy. Cases of solely laser barricade were not counted as surgery. Rhegmatogenous retinal detachment was defined as a retinal

elevation with any retinal break (found before or during surgery). All eyes with prior detachments – or tractional, exudative, and traumatic (retinal dialysis) retinal detachments – were excluded. Reoperations within the study period were excluded (i.e., only the first surgical intervention was counted).

The information collected included patient's age, gender, and affected eye, macula-off or macula-on detachment, date of RRD surgery, and history of CE. Macula-off RRD was defined as a macular elevation prior to or during surgery, or a visual acuity of less than 10/20 that could not be explained by other stated pathology, such as media opacities, amblyopia, macular or optic nerve pathology. All data were entered into a computer database.

In order to compare RRD incidence rates in our population to other populations we conducted a PubMed database search using the search terms "incidence", "population", "epidemiology", "rhegmatogenous", and "retinal detachment" in different combinations.

Statistical analyses

The annual incidence rate was calculated by dividing the number of new cases by the target population size. Bilateral cases were counted separately, as these are a rarity. A 95% confidence interval (CI) of the incidence rate was calculated. A Student's t-test was used to examine differences in the incidence of RRD between two groups (total RRD incidence in males versus females, RRD incidence in males versus females in the different age categories, RRD incidence between consecutive age categories for the total RRD population, and for males and females, respectively). A P-value < 0.05 was considered significant. Statistical analyses were performed using Microsoft Office Excel 11.0 (Microsoft Corp., Washington, USA).

RESULTS

Among the 16,485,787 residents of the Netherlands in 2009, 2998 new cases of RRD were treated. The incidence of RRD in the Netherlands in 2009 was 18.2/100,000 people (95% confidence interval [CI] = 11.4 - 18.8). Of all patients, 50 suffered from bilateral RRD, resulting in a bilateral RRD rate of 1.67%. A detached macula was found in 1633 eyes (54.5%), and the macula was attached at presentation in 1365 eyes (45.5%).

Age and gender distribution

The median age of the patients was 60 years (range = 9-99). This did not differ between males (median age 60 years [range 9-91]), and females (median age 60 years [range 10-99 years]). There was a significant increase in RRD incidence from 34 years of age onwards (*P* = 0.0036), and a significant decrease in incidence from 74 years of age onwards (*P* = 0.0033) (Table 1, Figure 1).

We noticed a peak incidence at 55-59 years of age with an incidence of 52.5/100,000 people (95% confidence interval [CI] = 29.4 - 56.8) (Figure 1).

Table 1: Actual numbers of individuals and incidences of rhegmatogenous retinal detachment per age category in the population of the Netherlands for males, females, and all individuals in 2009.

Age range (years)	Number of individuals[a]			Total with RRD		Males with RRD		Females with RRD		M-F ratio[b]
	Total	Male	Female	Number	Incidence	Number	Incidence	Number	Incidence	
< 5	931.6	476.7	454.9	0	0	0	0	0	0	NA
5-9	1010.6	517.0	493.6	1	0.10	1	0.2	0	0	NA
10-14	980.9	502.0	478.9	9	0.92	4	0.8	5	1.0	0.8:1
15-19	1010.5	516.3	494.3	14	1.39	1	0.2	13	2.6	0.1:1
20-24	996.9	504.3	492.5	34	3.41	20	4.0	14	2.8	1.4:1
25-29	992.0	498.4	493.6	37	3.73	16	3.2	21	4.3	0.8:1
30-34	1008.4	504.6	503.9	30	2.97	17	3.4	13	2.6	1.3:1
35-39	1236.6	620.7	615.9	65	5.26	33	5.3	32	5.2	1.0:1
40-44	1295.6	655.7	639.9	114	8.80	68	10.4	46	7.2	1.4:1
45-49	1271.5	641.0	630.5	210	16.52	121	18.9	89	14.1	1.3:1
50-54	1157.7	581.5	576.2	380	32.82	214	36.8	166	28.8	1.3:1
55-59	1081.1	544.2	536.9	567	52.45	328	60.3	239	44.5	1.4:1
60-64	1040.6	522.2	518.4	536	51.51	327	62.6	208	40.1	1.6:1
65-69	747.8	368.2	379.6	366	48.95	211	57.3	155	40.8	1.4:1
70-74	603.5	283.3	320.2	289	47.89	160	56.5	129	40.3	1.4:1
75-79	489.3	210.7	278.7	182	37.19	93	44.2	89	31.9	1.4:1
80-84	345.8	129.2	216.6	108	31.23	64	49.5	44	20.3	2.4:1
85-89	200.6	61.9	138.8	43	21.43	19	30.7	24	17.3	1.8:1
90-94	67.9	15.9	52.1	11	16.20	4	25.2	7	13.5	1.9:1
≥ 95	16.8	2.9	14.0	2	11.88	0	0	2	14.3	NA
Total	16485.8	8156.3	839.4	2998	18.19	1701	20.9	1296	15.6	1.3:1

RRD: rhegmatogenous retinal detachment; NA: not applicable. [a] Actual number is given number*1000. [b] Male-to-female ratio.
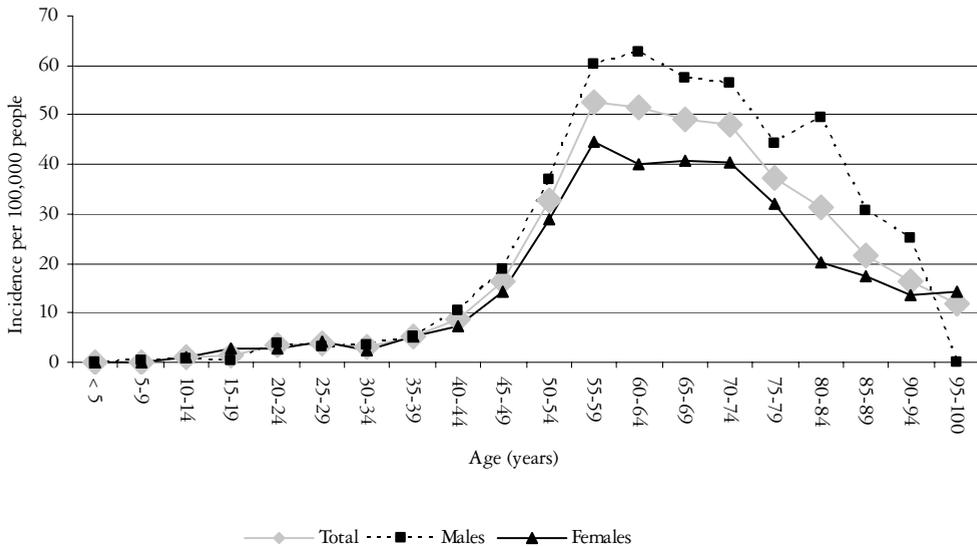
Figure 1: The incidence of rhegmatogenous retinal detachment in the Netherlands per 100,000 people in 2009.

Among the 2998 incident cases of RRD, 1701 involved males (56.7%), and 1296 involved females (43.3%), resulting in a male-to-female ratio of 1.3:1. The incidence of RRD was 20.9/100,000 people (95% confidence interval [CI] = 19.9 - 21.9) in males, and 15.6/100,000 people (95% confidence interval [CI] = 14.7 - 16.4) in females, respectively. The incidence differed significantly between males and females in the total group ($P < 0.0001$), and in the subpopulations aged 15-19 ($P = 0.0006$), 40-44 ($P = 0.027$), 45-49 ($P = 0.018$), 50-54 ($P = 0.0088$), 55-59 ($P = 0.0002$), 60-64 ($P < 0.0001$), 65-69 ($P = 0.0007$), 70-74 ($P = 0.0023$), 75-79 ($P = 0.016$), 80-84 ($P < 0.0001$), and 85-89 years ($P = 0.044$), respectively.

RRD in phakic eyes and eyes with prior CE

Of the 2998 RRD cases, 66.5% involved phakic eyes, and 33.5% involved eyes with prior CE. The median age of phakic RRD patients was 58 years (range 10-99). This did not differ between males (median age 59 years [range 14-91]) and females (median age 58 years [range 10-99]). We noticed an increase in absolute numbers of RRD in phakic eyes from age 35 onwards, peaking at 55-59 years of age (n = 406), and decreasing thereafter (Figure 2). Among the 1994 phakic RRD cases, 1105 involved males (55.4%), and 888 involved females (44.5%), resulting in a male-to-female ratio of 1.2:1. At age 75-79 years, there is a turning point in the percentage of phakic RRD eyes compared to RRD eyes with a history of CE (Figure 3).

The median age of patients with RRD in eyes with prior CE was 64 years (range 9-91). The median age was 63 years (range 9-91) for males, and 65 years (range 17-91) for females. We noticed an increase in absolute numbers of RRD in eyes with prior CE from age 40 onwards, peaking at 60-64 years

of age (n = 166), and decreasing thereafter (Figure 2). Among the 1004 cases, 596 (59.4%) involved males, and 408 (40.6%) involved females resulting in a male-to-female ratio of 1.5:1.
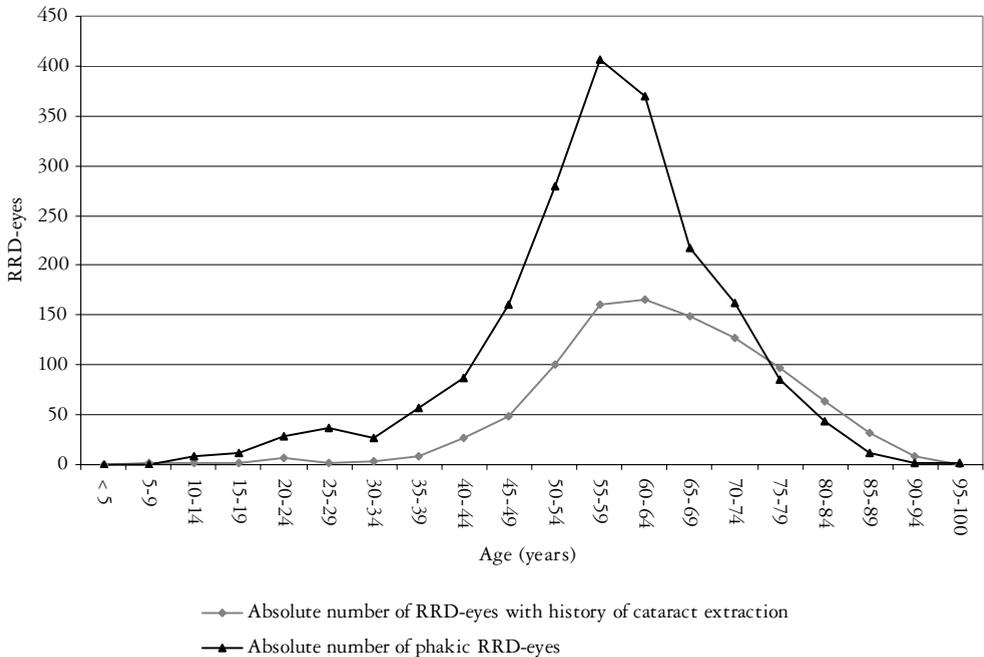

Figure 2: Absolute numbers of phakic rhegmatogenous retinal detachment (RRD) eyes and RRD eyes with a history of cataract extraction.
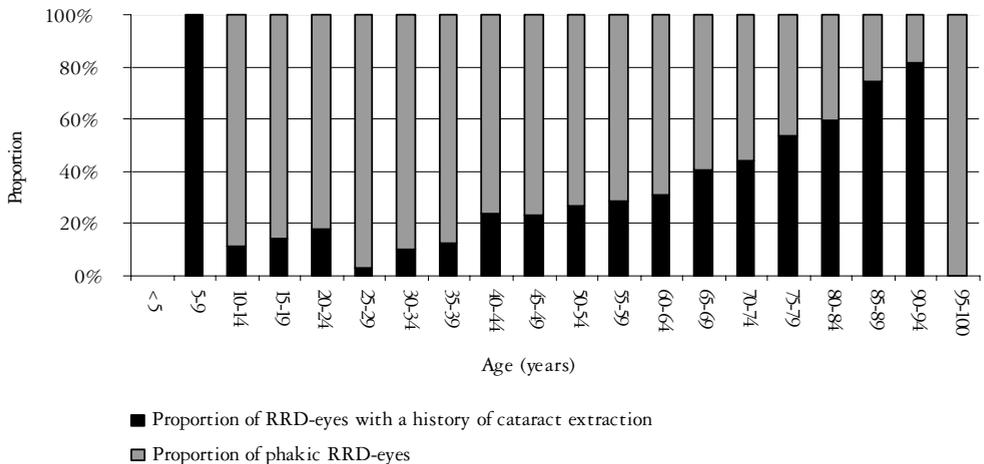

Figure 3: Proportion of phakic rhegmatogenous retinal detachment (RRD) eyes and RRD eyes with a history of cataract extraction.

DISCUSSION

As far as we are aware, we are reporting in this paper the highest RRD incidence rate thus far, which is in line with the increasing RRD incidence rates that have been reported over the past forty years.[4-12] Most importantly, the RRD incidence rates provided in our manuscript are highly reliable due to the population studied (i.e., the population studied was one of the largest, most stable, and well-defined populations), and the opportunity for uniform data collection (i.e., uniform diagnosis because of cooperation with "the Dutch RRD Study Group"). In line with previous reports, a peak incidence was observed in the middle-aged (55-59 years of age), while males were overrepresented in almost all age categories.[4-12,17-19] This suggests that RRD incidence is strongly dependent on demographic characteristics such as age and gender distribution. We noticed the highest numbers of phakic RRD patients at ages 55-59 years, and the highest numbers of post-CE RRD patients at ages 60-64 years. Also, the proportion of post-CE RRD increased with advancing age. Both observations suggest that phakic and post-CE RRD are different entities. The fact that RRD is still a sight-threatening condition is underscored by the presence of a macular detachment in more than half of the patients.

Study characteristics

Differing incidence rates between populations and within a population over a different time period can well be explained by the studied population (i.e., size, stability, defined borders, and the accessibility of the health-care system), and by the study design, including definition of diagnosis, and further by the prevalence of risk factors (i.e., age distribution, prevalence of refractive errors, phakic eyes, and eyes with previous CE) in the population studied.[4-12, 17-21] The provided RRD incidence rates in our manuscript are highly reliable, as our study adhered to the crucial factors in obtaining incidence rates. First, the studied population was one of the largest populations studied thus far.[4-12] Second, other studies accumulated data over several years, and thus their populations may have fluctuated because of immigration and emigration.[4,6-10,20] Demographic characteristics (e.g., age and gender distribution) are less reliable if the study period differs from the period, over which the demographic data have been accumulated. Further, the studied population was well defined, because there was minimal cross-border consumption of health care (i.e., surrounding countries have different languages, health-care accessibility, and health-care systems). In addition, we can assume that virtually all patients suffering from an RRD in the Netherlands visit an ophthalmologist, and are referred for treatment, because the health-care system in the Netherlands is affordable, easily accessible, and of high quality. Virtually no patients will refuse surgery. Exceptions may exist, however, for patients with very advanced stages of proliferative vitreoretinopathy (PVR) or who are in very poor health. Finally, definitions of RRD differed between studies. For instance, we excluded traumatic RRD (retinal dialysis) and reoperations, whereas other studies included such patients, resulting in slightly higher RRD incidences.[4-10,17,18,20,21]

The reported RRD incidence rate in our population may be underestimated. For instance, we used surgical care as a proxy for RRD incidence. In addition, it could be possible that a small proportion of Dutch RRD patients might have been operated on outside the Netherlands. Another limitation could be the retrospective character of the study.

RRD and age/population aging

The strong association between RRD incidence rates and age has been reported extensively. This association has been found to be strongest in phakic RRD patients.[4-10,17,18,20] Posterior vitreous detachment (PVD) is generally assumed to be the main cause of RRD in phakic eyes, since RRD is frequently associated with acute symptomatic PVD.[14,22] PVD is a rarity in individuals younger than 50 years of age; on average, its onset is at 60 years, with increasing prevalence thereafter.[22] This may well explain the observed median age and age peak in phakic RRD in our and other studies.[4-10,17,18,20] Pathophysiologically, this relationship is confirmed by the general presence of horseshoe-shaped tears at the central border of the vitreous base.[14,23] The relationship between PVD and age is in line with described lower RRD incidences in relatively younger populations[11,12,19,21] versus higher RRD incidences in relatively older populations, including our own.[6-8,16]

RRD and gender

The observed gender difference in RRD incidence in our study is supported by others,[8-11,19-21] but it is not found consistently.[5-7,17,18] Previous authors suggested that the attributable risk of RRD from ocular trauma may be higher in males than in females,[19] and consequently lead to a higher RRD incidence in males. We excluded traumatic RRD, and in addition the attributable risk of RRD from ocular trauma is reportedly low.[5,18,21] Although, high myopia has been considered an important risk factor for RRD,[4,5,7] the prevalence of myopia in the Dutch population is equal for males and females.[24] However, symptomatic posterior vitreous detachment (PVD) even though more common in females than males[22, 25-27] is more often complicated by a retinal tear in males, possibly resulting in a higher attributable RRD risk in males.[14] In addition, previous CE increases the risk of developing a PVD in due course[28,29]. In concordance to previous reports,[30] in the Netherlands the male-to-female ratio regarding CE was 2:3 as registered by cataract surgeons from 2000-2012 in the online cataract database of the Dutch Ophthalmologic Society (Dutch Ophthalmologic Society. Cataract Quality Registration [in Dutch][database online]). This in contrast to the overrepresentation of males in absolute pseudophakic RRD numbers in our and other studies.[30,31] One possible explanation for these inconsistencies may be a slightly unequal distribution of males and females across the different age groups.[4,6-9]

RRD and cataract extraction

It has been postulated that the cumulative risk of RRD is increased by a factor of 5 in eyes with a history of CE.[5] Possibly, the volume of performed CE in our population in recent years may be partly responsible for the high RRD incidence rates observed in this population.[32]

The increase in performed CE can be attributed to population aging, and hence a higher prevalence of cataracts. In addition, because of the success of phacoemulsification for CE, there has been a tendency to perform CE at an earlier stage.[33,34] Both factors have resulted in a higher volume of CE performed in the recent past. (Estimated numbers for the Netherlands are 38,000 CE performed in 1991; 80,000 in 1998; and 120,000 in 2003).[32]

In line with this, and in contrast to others, we found a high percentage of RRD patients with prior CE.[4,10,11] In parallel with the increase in the volume of cataract surgery in the Netherlands, there has been a shift in surgical technique. Extracapsular cataract extraction (ECCE) has been replaced by the safer procedure of phacoemulsification.[35,36] Furthermore, intracapsular cataract extraction (ICCE), the procedure holding the highest risk of postoperative RRD, has just about been abandoned.[35,36] Even though the relatively safer phacoemulsification technique probably mitigates the RRD risk in pseudophakic eyes to some extent, the overall contribution of CE to RRD incidence still seems to be significant.

Unfortunately, reliable incidence rates for phakic versus post-CE RRD cannot be provided, since the prevalence of phakic versus post-CE eyes in most populations, including our own, is unknown due to incomplete registration systems.[4,10,11] The differences in the shapes of the age-related distribution curves between phakic and post-CE RRD, and the shift in the proportion of phakic versus post-CE RRD eyes with advancing age suggest that phakic and post CE-RRD are different entities.[8,14,22,35-38] Several theories concerning the pathophysiological mechanisms on phakic versus post-CE RRD have been advocated. First, a newly induced PVD[37,38] in non-PVD eyes can occur, because CE causes mechanical[8] and biochemical changes[39] in the vitreous.[37-39] Also, a second mechanism could be at play, namely, the altered mechanical forces at the anterior vitreous base area because of the loss of lens volume.[40] This second mechanism would also explain the more anteriorly located small horseshoe-shaped tears that are frequently found in RRD eyes with prior CE.[40]

RRD, refractive error, and bilaterality

It has consistently been found that high myopia is associated with RRD, especially bilateral RRD.[4,5,7] Unfortunately, we could not make any assumption on the relationship between RRD and myopia, as the distribution of refractive errors in our population is not known. Furthermore, in that they are only for one single year, our data are too limited to draw any conclusions as to the risk of developing bilateral RRD. The risk of bilateral RRD varies among populations: for instance, in Sweden, 11.2% of subjects had bilateral RRD over a time period of ten years[4-7] compared to

6.7% in Minnesota (USA)[8] over a time period of twenty years.[8] In all series, fellow eyes have an increased risk of developing RRD in due course.[8,11]

RRD and macular status

Macular status at presentation is an important prognostic indicator of visual outcome.[2,3] We identified high numbers of macula-off detachment in our population.[8,9] One possible explanation for this high number was our chosen definition of macula-off detachment. Not only was the clinical observation of subretinal fluid, before or during surgery, regarded as macula-off detachment but eyes with VA ≤ 10/20 not explained by other ophthalmic pathology were also considered as such. This results in higher numbers of macula-off detachments compared to studies using lower VA values as a cut-off point. Both methods have their limitations, and the gold standard to determine pre-operative macular status would be performing a macular optical coherence tomography (OCT) and / or ultrasonography, but such tests are not routinely performed in RRD patients. Other explanations for this high rate of macula-off detachments include patient's and doctor's delay, or rapidly progressive detachments. Patient's delay could be partly due to inattention on the part of the patient, and unfamiliarity with RRD and its symptoms in the general population. Given the peak incidence at a given age and the possible relationship with previous CE, it could be helpful to better inform the population at highest risk. For instance, optometrists could inform patients with (high) myopia or presbyopia about the clinical symptoms of RRD. Furthermore, in ophthalmology departments it could be useful to emphasize the increased RRD risk after CE. This would be in line with the current CE guidelines from the Dutch Ophthalmic Society, which clearly state this risk.[32]

CONCLUSION

In summary, RRD incidence is highly dependent on demographic characteristics such as age and gender. Males have a higher risk than females, and a peak incidence is found at 50-55 years of age. A possible explanation for the high RRD incidence rate in our population may be due to the volume of performed CE in our population. We expect the RRD incidence in Western populations to increase due to an increase in the proportion of persons of advanced age (i.e., population aging), who therefore are at an increased risk for the development of RRD and cataract over the next decades.

Our data could be used to identify and inform those subpopulations at highest risk for RRD about the signs and symptoms of this disease. This possibly could result in a decrease in patient's delay and, concomitantly, in a decrease in macular detachment rates. In addition, our data can be a helpful tool for anticipating future health-care demand in the Netherlands.

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PART II
CLINICAL STUDIES