Incidence of rhegmatogenous retinal detachment in France from 2010 to 2016: seasonal and geographical variations

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Received 24 November 2020
Revised 28 January 2021
Accepted 17 February 2021

To cite: Ben Ghezala I, Mariet AS, Benzenine E, *et al*. *Br J Ophthalmol* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/bjophthalmol-2020-318457

ABSTRACT

Aims To investigate the annual and monthly hospital incidence rate of rhegmatogenous retinal detachments (RRDs) from 2010 to 2016 in France at the national and regional levels.

Methods In this nationwide database study, we identified hospital and clinic admissions of French residents for a first episode of RRD in France during 2010–2016 from the national administrative database. The annual and monthly hospital incidence rates of RRD per 100 000 population were calculated for the whole country and for each region.

Results The average annual national hospital incidence rate of RRD was 21.97±1.04 per 100 000 population. The annual national hospital incidence rate of RRD was the lowest in 2010 (20.91 per 100 000 population) after which it increased until 2015 (23.55 per 100 000 population). The average monthly national RRD hospital incidence rate was the highest in June (2.03±0.12 per 100 000 population) and the lowest in August (1.60±0.09). The average annual age-standardised and sex-standardised regional hospital incidence rate was the highest in Guadeloupe and Pays de la Loire (28.30±2.74 and 26.13±0.84 per 100 000 population, respectively) and the lowest in French Guiana and Martinique (15.51±3.50 and 17.29±2.12 per 100 000 population, respectively).

Conclusions The average annual national hospital incidence rate of RRD increased from 2010 to 2015. The hospital incidence rate of RRD seemed to vary according to season and geographical location.

INTRODUCTION

Rhegmatogenous retinal detachment (RRD) is defined by the presence of a full-thickness retinal break which leads to accumulation of liquefied vitreous under the neurosensory retina, separating it from the retinal pigment epithelium. RRD is an acute and severe retinal disease, whose treatment involves surgery.[1] Predisposing factors are mainly older age, male sex, diabetes,[1] myopia,[2] cataract surgery,[3] trauma,[4] posterior vitreous detachment and vitreoretinal changes.[1] However, the triggers in this sudden acute pathology remain unknown. Some environmental triggers such as temperature, atmospheric pressure and solar radiation have been investigated.[5–7] Identifying such factors is crucial to understanding the physiopathology of RRD, but also to raising awareness about their dangers and establishing prevention strategies.

Several studies assessed the incidence of RRD in different countries.[8–12] Some authors suggested the existence of seasonal and geographical variations in the incidence of RRD.[13] However, most of these studies included only a small number of cases and their statistical power was limited.[13] The time periods and geographical areas studied were also limited,[7 14] and therefore their results need to be confirmed on a larger scale. To our knowledge, no nationwide population-based study has been conducted in France to date to assess the incidence rate of RRD and the existence of seasonal and geographical variations. We aimed to investigate the annual and monthly hospital incidence rates of RRD in France from 2010 to 2016 at the national and regional levels.

MATERIALS AND METHODS

Study design

We conducted a nationwide observational retrospective population-based study.

Data source

The French national administrative database (*Programme de Médicalisation des Systèmes d'Information* (PMSI)) collects the discharge abstracts from all hospitals in France. It was initiated in 1991 and extended to all public and private hospitals in France in 1997. Diagnoses are coded following the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10). The medical activity recorded in this database is used to allocate hospital budgets. The accuracy of the database has been evaluated.[15–17]

Data extraction

We identified all hospital and clinic admissions of French residents for a first episode of RRD in France from 1 January 2010 to 31 December 2016 by means of billing codes from the PMSI. RRD diagnoses were identified on the basis of two codes in the ICD-10 (H330 and H332). Patients admitted for RRD in the two previous years were excluded from the analysis so as to avoid the inclusion of patients with a history of RRD. We retained the sex and age of the patients as well as the month and year of their admission for RRD. We identified the

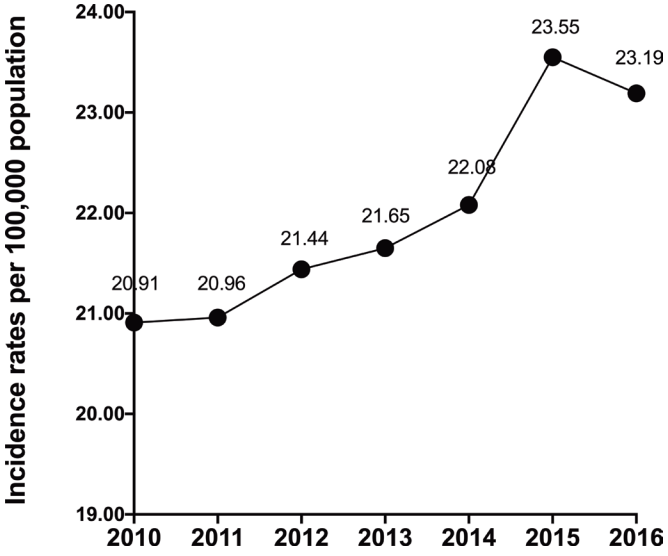

Figure 1 National hospital incidence rate of rhegmatogenous retinal detachment per 100 000 population between 2010 and 2016.

patients' locations through their geographic code of residence recorded in the PMSI. France is currently divided into 101 counties gathered in 18 regions.

Statistical analyses

The annual and monthly hospital incidence rates of RRD per 100 000 population were calculated for the entire period for the whole country and for each region. The numerator was the number of admissions for the first episode of RRD in patients living in France as a whole and in each French region. The denominator, that is, the number of inhabitants in France and in each French region, was obtained from the census data of the French National Institute of Statistics and Economic Studies.[18] All overseas regions of France were included except for Mayotte, as data were not available before 2014. The average population of France was 65 597 957 between 2010 and 2016. The number of French ophthalmologists per region was retrieved from a national data set of medical doctors.[19] Age and sex standardisation was performed using the direct method and the French standard population. Age-standardised and sex-standardised incidence rates of RRD per 100 000 population were estimated with their 95% CIs. A χ^2 test was used for univariate analysis. Pearson's correlation test was used to assess the correlation between the regional incidence rates of RRD and the number of French ophthalmologists per region. The tests were two-tailed and p values <0.05 were considered statistically significant. Statistical analyses were performed with SAS software (V.9.4; SAS Institute). The geographic map showing the age-standardised and sex-standardised regional hospital incidence rates was created using the online open source Khartis software.[20]

Table 1 Incidence rates of rhegmatogenous retinal detachment for each age group, in years, per 100 000 population, with the age-standardised rate (ASR) for each period

	0–19 years	20–39 years	40–59 years	60–74 years	75+ years	ASR	P value
Female							
2010	1.24	4.60	18.22	43.26	35.12	16.28	<0.001
2011	1.21	4.34	17.81	42.35	33.68	15.95	<0.001
2012	0.90	4.62	17.87	42.93	34.40	16.26	<0.001
2013	1.08	4.42	18.33	42.41	34.38	16.43	<0.001
2014	1.34	4.40	17.93	43.26	34.06	16.60	<0.001
2015	1.25	4.69	19.08	45.46	36.65	17.70	<0.001
2016	1.18	4.66	18.67	44.32	33.83	17.20	<0.001
Male							
2010	1.73	6.10	30.75	79.13	67.66	25.85	<0.001
2011	2.19	6.21	29.39	80.35	70.55	26.31	<0.001
2012	2.09	6.64	31.32	78.88	69.75	26.95	<0.001
2013	2.20	6.16	30.46	81.44	68.91	27.22	<0.001
2014	2.21	5.97	31.50	83.56	67.10	27.92	<0.001
2015	2.25	6.80	33.30	88.18	69.62	29.77	<0.001
2016	2.43	6.63	33.18	85.74	68.92	29.57	<0.001

RESULTS

We identified 101 085 admissions for a first episode of RRD in France between 1 January 2010 and 31 December 2016. The mean age of the patients was 61.7±15.3 years and 61.0% of them were men. The average annual age-standardised and sex-standardised hospital incidence rate of RRD at a national level was 21.97±1.04 per 100 000 population. The annual age-standardised and sex-standardised national hospital incidence rate of RRD was the lowest in 2010 (20.91 per 100 000 population) after which it increased until 2015 (23.55 per 100 000 population) (figure 1). National hospital incidence rates were analysed by age and sex. The age-standardised national hospital incidence rates were higher for men (27.65 per population average between 2010 and 2016) than for women (16.63 per population average between 2010 and 2016) (p<0.001). The hospital incidence rates were higher in the age group between 60 and 74 years than in other age groups for both men and women (p<0.001) (table 1).

The average monthly age-standardised and sex-standardised national RRD hospital incidence rate was the highest in June and July (2.03±0.12 and 1.99±0.17 per 100 000 population, respectively) and the lowest in August and February (1.60±0.09 and 1.67±0.09 per 100 000 population, respectively) (p<0.001) (figure 2).

We calculated the average annual age-standardised and sex-standardised hospital incidence rate of RRD in France between 2010 and 2016 according to region. The hospital incidence rate of RRD was different according to region (p<0.001) and was the highest in western and southern France (figure 3). The

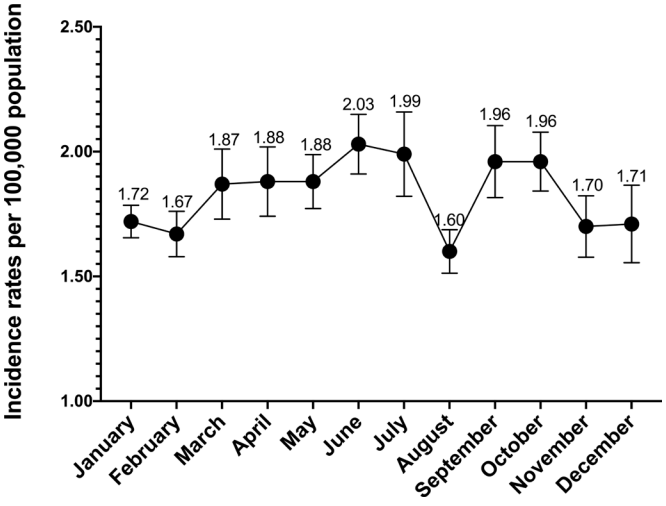

Figure 2 Average (mean and SD) monthly national incidence rates of rhegmatogenous retinal detachment in France per 100 000 population between 2010 and 2016.

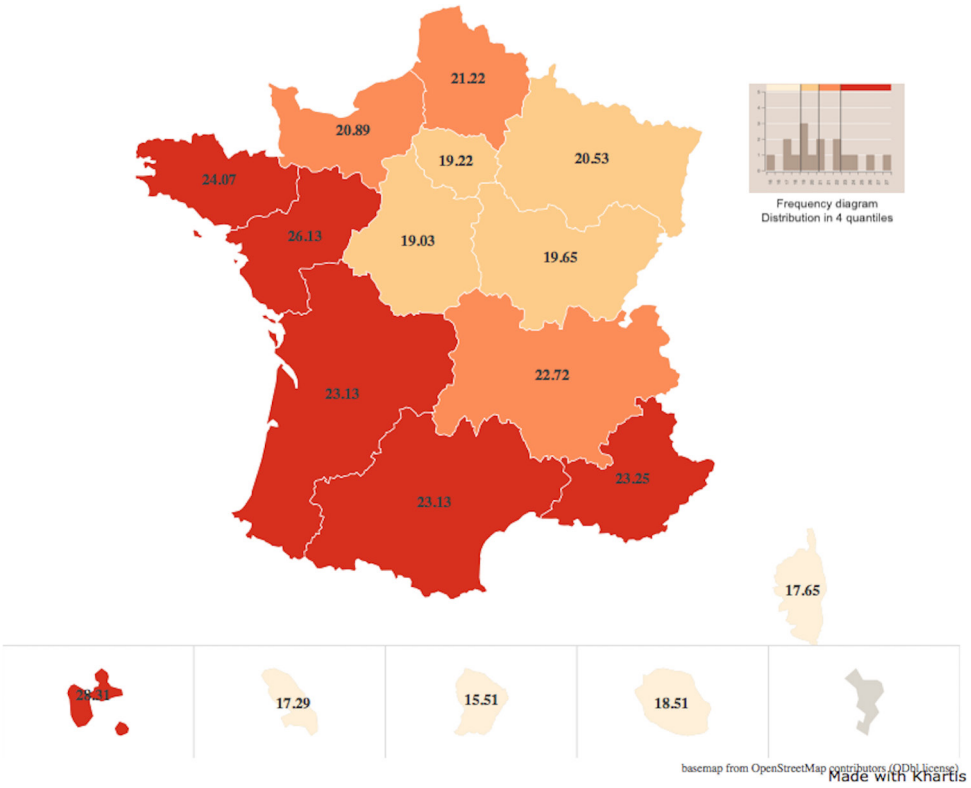

Figure 3 Average annual age-standardised and sex-standardised incidence rate of rhegmatogenous retinal detachment per 100 000 population in each region in France between 2010 and 2016.

average annual age-standardised and sex-standardised regional hospital incidence rate was the highest in Guadeloupe and Pays de la Loire (28.30±2.74 and 26.13±0.84 per 100 000 population, respectively) and the lowest in French Guiana and Martinique (15.51±3.50 and 17.29±2.12 per 100 000 population, respectively). We did not find any statistically significant correlation between the annual regional RRD hospital incidence rates and the density of regional ophthalmologists ($r=0.43$, $p=0.09$).

A subgroup analysis was performed on patients aged over 60 years. We found the same seasonal variation pattern as the highest incidence rates of RRD were found in June and July ($p<0.001$). We also found a similar geographical pattern as the highest regional hospital incidence rates were found in Guadeloupe and Pays de la Loire (results not shown).

Finally, for each region, we calculated the average seasonal age-standardised and sex-standardised hospital incidence rate of RRD between 2010 and 2016. In 10 out of 12 mainland France regions, the average age-standardised and sex-standardised RRD hospital incidence rate was the highest in spring and summer, although the differences were not statistically significant (table 2).

DISCUSSION

We reported an average annual age-standardised and sex-standardised national hospital incidence rate of RRD of 21.97±1.04 per 100 000 population. This rate was higher than most other nationwide studies in the literature.[8–11] However, the design of these studies was different to ours. First, we used a nationwide medico-administrative database. Second, in our study we identified all admissions for a first episode of RRD and did not calculate a person-based rate. Our results are similar to a recent European study that examined the rate of admissions for retinal detachment.[12] Shah *et al* found an annual retinal detachment admission rate of 24.0 per 100 000 population in 2011 in England.[12] Third, the French population structure may be different from the population structure in other countries, with a high proportion of patients aged over 65 years.[21]

We found that the annual national hospital incidence rate of RRD increased by 12.63% from 2010 to 2015. Such a trend has been observed by other authors for RRD.[12] We have observed the same trend for cataract and macular surgeries,[22 23] which may explain this increasing incidence of RRD as they are well-known iatrogenic risk factors for RRD.[3] Moreover, diabetes is a known risk factor for RRD,[1] and thus the influence of diabetes, which is known to be increasing, should be considered another contributing factor.[24] As age is also a risk factor for RRD, the population ageing in France may contribute to the increase of the incidence of RRD.[25] The inter-relationship of all these trends need to be further explored. We found an increased rate of RRD in men, as reported by other authors.[26] The peak incidence rate of RRD was seen in the 60-year to 74-year age group for both women and men, which is consistent with the literature.[8 10]

We observed a seasonal variation in the hospital incidence rate of RRD with a maximum incidence rate in June and July, which confirms a pattern previously observed in other countries from the northern hemisphere.[7 13 14] The lower incidence reported in August is probably related to the summer holidays, with the majority of the French population being on vacation,[27] especially abroad. The higher hospital incidence rate of RRD in summer could be linked to different meteorological parameters such as temperature, solar radiation[7] and barometric pressure.[5] Indeed, experimental studies have suggested these parameters affect the eye. The ALIENOR study has shown that ambient ultraviolet exposure may modify the biomechanical properties of the cornea.[28] Other studies have described an effect of temperature on the vitreous and the retina, enhancing posterior vitreous

Table 2 Average seasonal and annual age-standardised and sex-standardised incidence rates of rhegmatogenous retinal detachment per 100 000 population in each region of France between 2010 and 2016

	Autumn	Winter	Spring	Summer	Whole year	P value
Northwest						
Hauts-de-France	5.02 (0.30)	5.28 (0.31)	5.56 (0.31)	5.35 (0.31)	21.22 (0.61)	0.67
Ile-de-France	4.80 (0.22)	4.63 (0.21)	5.07 (0.22)	4.72 (0.21)	19.22 (0.43)	0.52
Normandie	4.97 (0.38)	4.90 (0.38)	5.43 (0.40)	5.58 (0.40)	20.89 (0.78)	0.52
Bretagne	6.16 (0.42)	5.64 (0.40)	6.36 (0.43)	5.91 (0.41)	24.07 (0.84)	0.64
Pays de la Loire	6.48 (0.42)	6.37 (0.41)	6.71 (0.43)	6.56 (0.42)	26.13 (0.84)	0.96
Centre-Val de Loire	4.75 (0.42)	4.53 (0.41)	4.98 (0.43)	4.78 (0.42)	19.03 (0.83)	0.88
Northeast						
Bourgogne-Franche-Comté	4.62 (0.39)	4.59 (0.39)	5.29 (0.42)	5.15 (0.41)	19.65 (0.81)	0.45
Grand Est	4.91 (0.30)	4.88 (0.29)	5.47 (0.31)	5.28 (0.31)	20.53 (0.60)	0.45
Southwest						
Nouvelle Aquitaine	5.57 (0.29)	5.41 (0.29)	6.18 (0.31)	5.97 (0.30)	23.13 (0.60)	0.22
Occitanie	5.53 (0.30)	5.65 (0.30)	6.25 (0.32)	5.70 (0.31)	23.13 (0.62)	0.36
Southeast						
Auvergne-Rhône-Alpes	5.64 (0.27)	5.46 (0.26)	5.90 (0.27)	5.71 (0.27)	22.72 (0.54)	0.72
Provence-Alpes-Côte d'Azur	5.80 (0.33)	5.56 (0.32)	6.05 (0.34)	5.84 (0.33)	23.25 (0.66)	0.76
Corse	5.16 (1.20)	3.73 (1.02)	5.12 (1.20)	3.65 (1.02)	17.65 (2.22)	0.65
Overseas regions						
Guadeloupe	6.23 (1.29)	7.34 (1.39)	7.72 (1.44)	7.02 (1.36)	28.30 (2.74)	0.91
Martinique	4.93 (1.13)	4.27 (1.04)	3.62 (0.97)	4.48 (1.08)	17.29 (2.12)	0.86
French Guiana	4.50 (1.91)	4.29 (1.85)	3.21 (1.68)	3.51 (1.54)	15.51 (3.50)	0.93
La Réunion	4.68 (0.92)	4.47 (0.89)	4.89 (0.92)	4.48 (0.90)	18.51 (1.82)	0.99

detachment.[29 30] However, the higher RRD incidence observed in summer could also be explained by traumatic RRD induced by outdoor activities.[14]

We found a higher hospital incidence rate of RRD in western and southern France. This may be due to differences in temperature, solar radiation or barometric pressure. Lin *et al* reported an association between the monthly rate of retinal detachment, temperature and barometric pressure. In France, the huge climatological disparities between regions could explain the geographic variations in the RRD incidence rate. For example, in Occitanie in October 2016, the average temperature was 7.4°C higher and the barometric pressure 32.4 hPa higher than in Grand Est.[31] However, the variations in the RRD incidence rate could also be attributed to population characteristics and differences in genetics, for example, in ocular axial length or ethnicity, as found by others.[32] These hypotheses need to be studied further. We could not explain the considerable difference in the hospital incidence rate of RRD between Guadeloupe (28.30±2.74 per 100 000 population) and Martinique (15.51±3.50 per 100 000 population), two islands in the French Indies which have a similar ophthalmologist density.[19] Further research is needed to study healthcare pathways in ophthalmology in the French Indies.

Our study has some limitations. First, using a medico-administrative database did not enable us to access detailed clinical information. Therefore, we could not investigate well-known risk factors of RRD such as myopia, diabetes and trauma. Moreover, we could not focus our study on spontaneous RRD. Second, to study the location of the RRD cases, we chose to rely on the patients' geographic codes of residence and not on the hospital geographic code. However, some patients may have experienced RRD in a different region than their geographic code of residence. Third, there may be some coding disparities in France, which could partly contribute to the geographical variations in the RRD hospital incidence rate. However, coding in the PMSI database is used as a basis for determining the budget allocation of healthcare facilities. Thus, coding accuracy is highly recommended and is subject to quality inspection.

Nevertheless, our study has several strengths. This was a nationwide study over a 7-year period using an exhaustive medico-administrative database. We calculated the age-standardised and sex-standardised hospital incidence rate of RRD to take into account demographic variations between regions.

The average annual national hospital incidence rate of RRD increased from 2010 to 2015. The monthly national hospital incidence rate of RRD seemed to vary according to season. The hospital incidence rate of RRD varied according to geographical location. The relationship between local climatological data and the RRD incidence rate warrants further investigation. These results should be taken into account so as to match the capacity in retinal surgery with the need for treatment of patients.

Contributors Conception and design: IBG, ASM, EB, P-HG, AMB, CQ, CPC-G. Data acquisition: IBG, ASM, EB, FB, CQ. Drafting the article: IBG, AMB, CPC-G. Final approval of the version to be published: IBG, ASM, EB, P-HG, FB, AMB, CQ, CPC-G.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests AMB is a consultant for Aerie, Allergan, Bausch Lomb, Santen and Théa. CPC-G is a consultant for Alcon, Allergan, Bausch Lomb, Bayer, Horus, Novartis, Roche and Théa.

Patient consent for publication Not required.

Ethics approval The use of the PMSI database was approved by the National Commission for Data Protection (*Commission Nationale de l'Informatique et des Libertés* no. 919086), and this study adhered to the tenets of the Declaration of Helsinki.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. Pseudoanonymised and encrypted data were extracted from

the health data hub. Data were handled by authorised personnel in Dijon University Hospital according to health data hub security guidelines.

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