

Seasonal Variation in the Occurrence of Retinal Vein Occlusion: A 4-Year Case Control Study

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Research article

Keywords: retinal vein occlusion; seasonality; risk factors

Posted Date: November 11th, 2019

DOI: <https://doi.org/10.21203/rs.2.17160/v1>

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Version of Record: A version of this preprint was published on July 6th, 2020. See the published version at <https://doi.org/10.1186/s12886-020-01534-6>.

Abstract

Retinal vein occlusion (RVO) is a common retinal vascular disease that causes a loss of vision. Therefore, we investigated whether there is seasonal variation in the onset of RVO, to examine the possibility of preventing it. Methods: Patients with RVO who were treated at the Juntendo University Urayasu Hospital between April 2013 and March 2017 were included in this retrospective study. The season in which the RVO occurred was recorded for each case, and the cases were grouped into 2-month periods and classified by age, sex and hypertension status. The frequency of occurrence of RVO across seasons was compared using a chi-squared test. Results: A total of 348 patients with RVO presented during the study period, with information regarding the date of RVO onset. The cohort of 348 consisted of 167 males and 181 females who, overall, had a mean age of 64.0 years (range 17–96 years). The highest incidence of RVO onset was during January/February, with the lowest incidence during July/August. Patient age, sex and hypertension status did not influence the results. Conclusions: The seasonal onset of RVO tended to be higher in January and February and lower in July and August. These findings suggest that eyecare professionals should be more vigilant in watching for the occurrence of RVO during winter, regardless of the patient's sex, age or hypertension status. Keywords: retinal vein occlusion; seasonality; risk factors

Background

Retinal vein occlusion (RVO) is a one of the vascular-occlusion diseases. The retinal vein narrows from mechanical pressure caused by arteriosclerosis, either within the arteriovenous crossing site in branch retinal vein occlusion (BRVO), or within the lamina cribrosa in central vein occlusion (CRVO), resulting in impairment of the venous blood flow. This can contribute to stasis, thrombosis and occlusion. RVO is the second most common retinal vascular disease after diabetic retinopathy, and causes a loss of vision due to macula edema [1,2].

Global epidemiological data indicate that the prevalence of RVO is 5.2/1000 [3]. Risk factors for RVO include hypertension, diabetes, increasing age, high body mass index, loss of protein C, loss of protein S, loss of antithrombin III and high antiphospholipid antibodies [4-6].

Cerebral infarction is a vascular occlusion similar to RVO. While there are studies showing that the occurrence of cerebral infarction is highest in summer [7,8], there are also studies showing that it is highest in winter [9,10]. The risk of myocardial infarction has also been reported to be highest in winter [11]. However, there has been limited investigation into whether climatic conditions are associated with the onset of RVO, and the existing findings show inconsistencies. Therefore, we assessed whether there was seasonal variation in the occurrence of RVO.

Methods

Diagnosis of RVO (either BRVO or CRVO) was made by confirming the presence of retinal hemorrhage and macular edema on fundus examination. Based on retrospective analysis of medical records, patients

with RVO who were treated at the Juntendo University Urayasu Hospital between April 2013 and March 2017 were eligible for inclusion in this study. From those eligible patients, only patients with a defined date of disease onset were included in the final study cohort. The cases were grouped into 2-month periods based on the date of RVO onset and classified by age (<65-years-old or ≥ 65), sex and hypertension status. Hypertension status was established by patient self-report or based on medical records citing a systolic blood pressure of >140 mmHg, for patients whose medical history was unknown.

Statistical analysis

Data are presented as numbers or percentages. Whether the percentages of patients in each of the six groups were equal was assessed using a chi-squared test. The statistical analyses were conducted using SPSS version 26.0 (IBM, Chicago, IL, USA). A P-value <0.05 was considered significant.

Results

A total of 348 eyes with RVO, with known date of onset, were examined during the study period. In cases where RVO was present in both eyes, the eye which presented earlier was included in the study results. Of the 348 patients with a known onset date, 281 patients were diagnosed with BRVO and 67 patients with CRVO. The mean age of the patients was 64.0 years (range 17–96 years).

All cases

Overall, there were 75 cases (21.6%) with an onset in the January/February period, 56 cases (16.1%) in March/April, 73 cases (21.0%) in May/June, 40 cases (11.5%) in July/August, 54 cases (15.5%) in September/October and 50 cases (14.4%) in November/December. The distribution of cases among the 6 groups was not even, with a trough in July/August and peaks in January/February and May/June (P=0.007, Figure 1).

Hypertension

There were 186 cases of RVO in patients with hypertension (53.4%) and 162 cases in patients without hypertension (46.6%). The highest incidence of RVO in patients with hypertension was found within the January/February period, with 43 cases (23%; see Figure 2). The lowest incidence of RVO in patients with hypertension was found within the July/August period, with 120 cases (10.8%). The highest incidence of RVO in patients without hypertension was found to be in the May/June period, with 35 cases (21.6%; see Figure 2). The lowest incidence of RVO in patients without hypertension was found within the July/August period, with 20 cases (12.3%).

Sex

Males accounted for 167 of the eyes with RVO (48.0%), with females accounting for the other 181 eyes (52.0%). Among the males, the highest incidence of RVO onset was found in the January/February period, with 39 eyes (23.3%; see Figure 3), and the lowest incidence was found in the November/December period, with 17 eyes (10.2%). Among the females, the highest incidence of RVO onset was found in the May/June period, with 42 eyes (23.2%; see Figure 3). The lowest incidence was found within the July/August period, with 15 eyes (8.3%).

Age

Patients <65-years-old accounted for 160 eyes with RVO (46.0%), whereas those aged ≥ 65 accounted for 188 eyes (54.0%). The highest incidence of RVO among patients aged <65 was found within the May/June period, with 36 eyes (22.5%; see Figure 4); the lowest incidence was in the September/October period, with 17 eyes (10/6%). For patients aged ≥ 65 , the highest incidence was found within the January/February period, with 40 eyes (21.3%; see Figure 4); the lowest incidence was in the July/August period, with 18 eyes (9.6%).

Discussion

In this study, we investigated whether seasonal climatic conditions had an impact on the onset of RVO. There is significant seasonal variation in climatic conditions such as temperature, atmospheric pressure, humidity, sunshine, rainfall and wind velocity. The impact of weather conditions on the onset of stroke or myocardial infarction has been examined, with temperature variation found to be a risk factor. The highest mortality rate is found in regions where the mean temperature is approximately 0 °C and the diurnal variance of the temperature is the biggest, ranging approximately 8–10 °C. In northeastern Japan, such climatic conditions in winter seem to be risk factors for stroke or myocardial infarction [12]. In contrast, there is limited evidence indicating whether climatic conditions represent risk factors for RVO onset. A Swedish study found a significant association between the onset of CRVO and the winter–spring period [13]. In London, the onset of CRVO showed significant cyclic variation, being most frequent in the months of September through February [14]. In Taiwan, the incidence of RVO is significantly associated with the seasons, with a peak in January [15]. All of these studies were conducted in the Northern Hemisphere, meaning that the seasonal variation in temperature would be similar to that experienced in Japan.

The results in those previous studies [13–15] were similar to those in this study, with a higher incidence of RVO in winter (January/February) and a lower incidence in summer (July/August). However, studies conducted in Iowa City, Iowa, USA and (countrywide) in Armenia did not find any seasonal variation in the

onset of CRVO [16,17]. The average monthly temperatures in each of the previous study locations are shown in Figure 5. A study investigating seasonal variation in stroke onset found that there was only an association in locations where the annual temperature differential was greater than 10 °C [19]. In the aforementioned studies that found significant seasonal variation in the onset of RVO, the annual temperature differential was more than 10 °C. However, the studies conducted in Iowa City and Armenia, which did not find any seasonal variation in the onset of RVO, were also in regions that have an annual temperature differential of more than 10 °C. Therefore, the conclusion regarding the impact of the temperature differential is not universally applicable. It is anticipated that factors such as patient race and access to heating equipment could influence these findings, and future studies will need to elucidate the impact of those factors, as well as explore additional geographical regions, to clarify the influence of weather conditions on RVO.

In this study, RVO tended to develop more in January/February and May/June and less in July/August. The RVO rates may be related to low temperatures in January and February and high humidity in May and June (the rainy season in Japan). In another vascular occlusive disease, cerebral infarction, some studies showed that its occurrence was highest in summer [7,8], some in winter [9,10]. As possible mechanisms contributing to vascular occlusion, it has been suggested that arteriosclerosis and venous obstruction are more prominent during winter, with dehydration prevalent in the summer [20]. As we found the incidence of RVO to be lowest during the summer, dehydration may not be a risk factor for the onset of this condition. In addition, the onset of cerebral hemorrhage and myocardial infarction have been found to be lower in summer and higher in winter [21], which is in accordance with the findings of this study.

Hypertension has been reported to be a major risk factor for cerebral hemorrhage and myocardial infarction, and is believed to also be important for the development of RVO [22]. Therefore, in the pathophysiology of RVO, it is expected that high blood pressure would be a more important factor than is dehydration. However, because there was no dependence of RVO onset on hypertension status in the present study, it is possible that fluctuation in blood pressure within an individual could be a risk factor. Regarding the increased risk of arteriosclerosis, vein occlusion and hypertension during winter, several studies have investigated these elements. Low temperature is associated with an increase in blood viscosity. Low temperature may also cause an increase in platelets, erythrocytes and fibrinogen, and a decrease in antithrombin III [4,5]. Catecholamines, cholesterol and vasopressin increase during winter [23]. It has also been suggested that lower blood levels of vitamin D in winter may be related to an increased incidence of CRVO [24]. A negative correlation between atmospheric pressure and systolic blood pressure has also been observed [25]. Finally, respiratory and circulatory system parameters, such as ventilation, heart rate, blood pressure and red blood cell count, increase when the temperature or atmospheric pressure decreases [26].

This study had some limitations. There was a recruitment bias with our cohort, whereby patients were only eligible to be included in the study if they visited the hospital. This excluded patients who were asymptomatic or those who did not visit the hospital because of a lack of concern about their condition.

Of the patients who did visit the hospital, those for whom the date of RVO onset could not be established were excluded from the study; which may also introduce some bias. Finally, as this study was only conducted over a short period (36 months) and at a single facility, future studies should focus on longer-term recruitment and multiple sites.

Conclusions

It is necessary to be vigilant about the possible occurrence of RVO in winter, regardless of the patient's sex, age and hypertension status. In this study, we found that lower temperatures may be involved in the onset of RVO, but the mechanism is unknown. Future studies should examine RVO subtypes such as BRVO and CRVO, and ischemic and non-ischemic types. Such studies should also incorporate blood tests including coagulation factors, blood cell components and hormones.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Juntendo University Urayasu Hospital, and the study adhered to the tenets of the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

All data generated or analyzed during this study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflicts of interest.

Funding

There were no funding sources for this study.

Authors' contributions

MM carried out the entire procedure, including the literature search, extracted the data, drafted the manuscript, and revised and submitted the manuscript. YS conceived of the study, performed the statistical analysis, coordinated and participated in the entire process of drafting and revising the manuscript. NE helped supervise the project. All authors read and approved the final manuscript.

Acknowledgements: We thank Claire Barnes, PhD, from Edanz Group (www.edanzediting.com/ac) for editing a draft of this manuscript.

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Figures

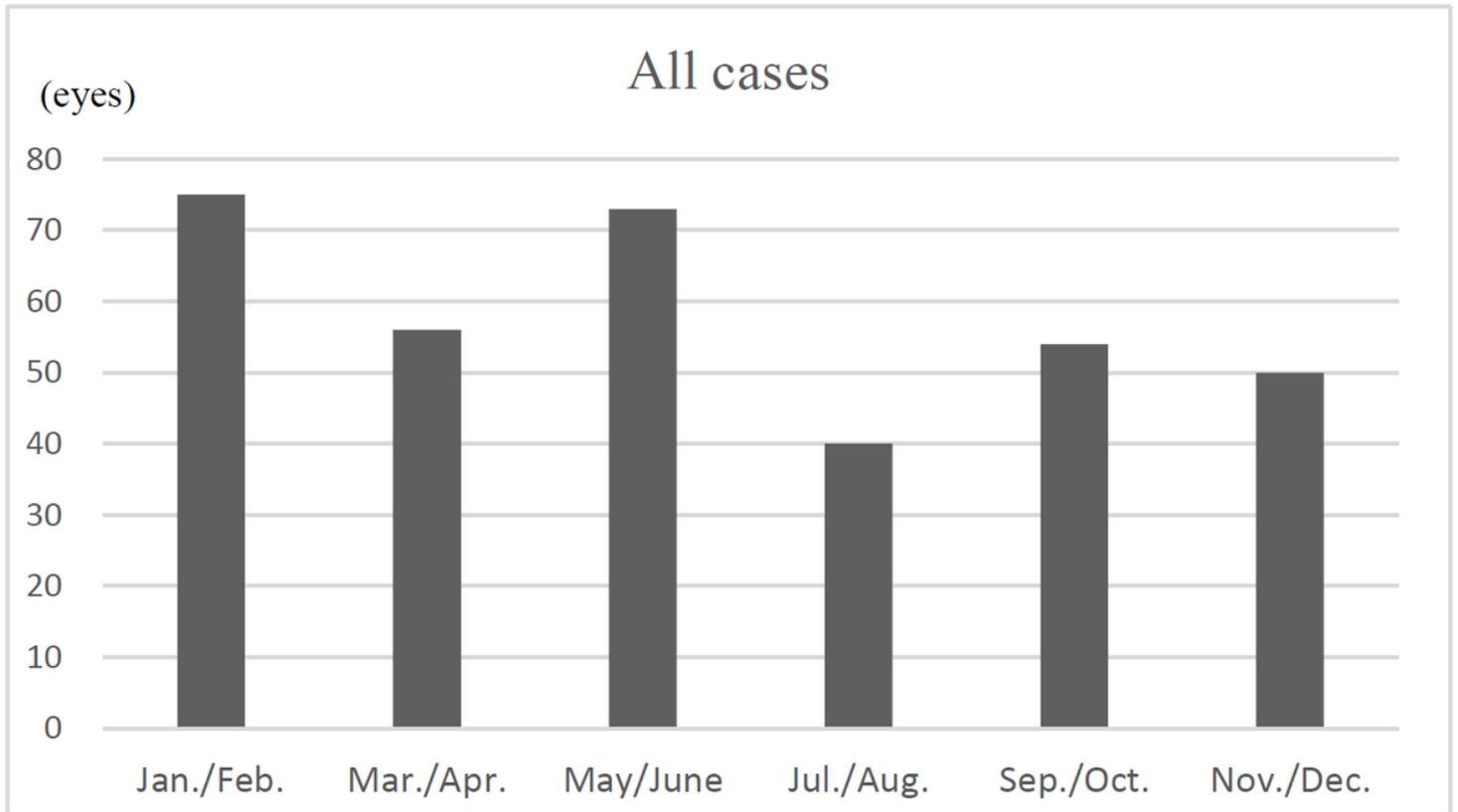


Figure 1

Onset periods for all 348 cases with a known month of retinal vein occlusion onset.

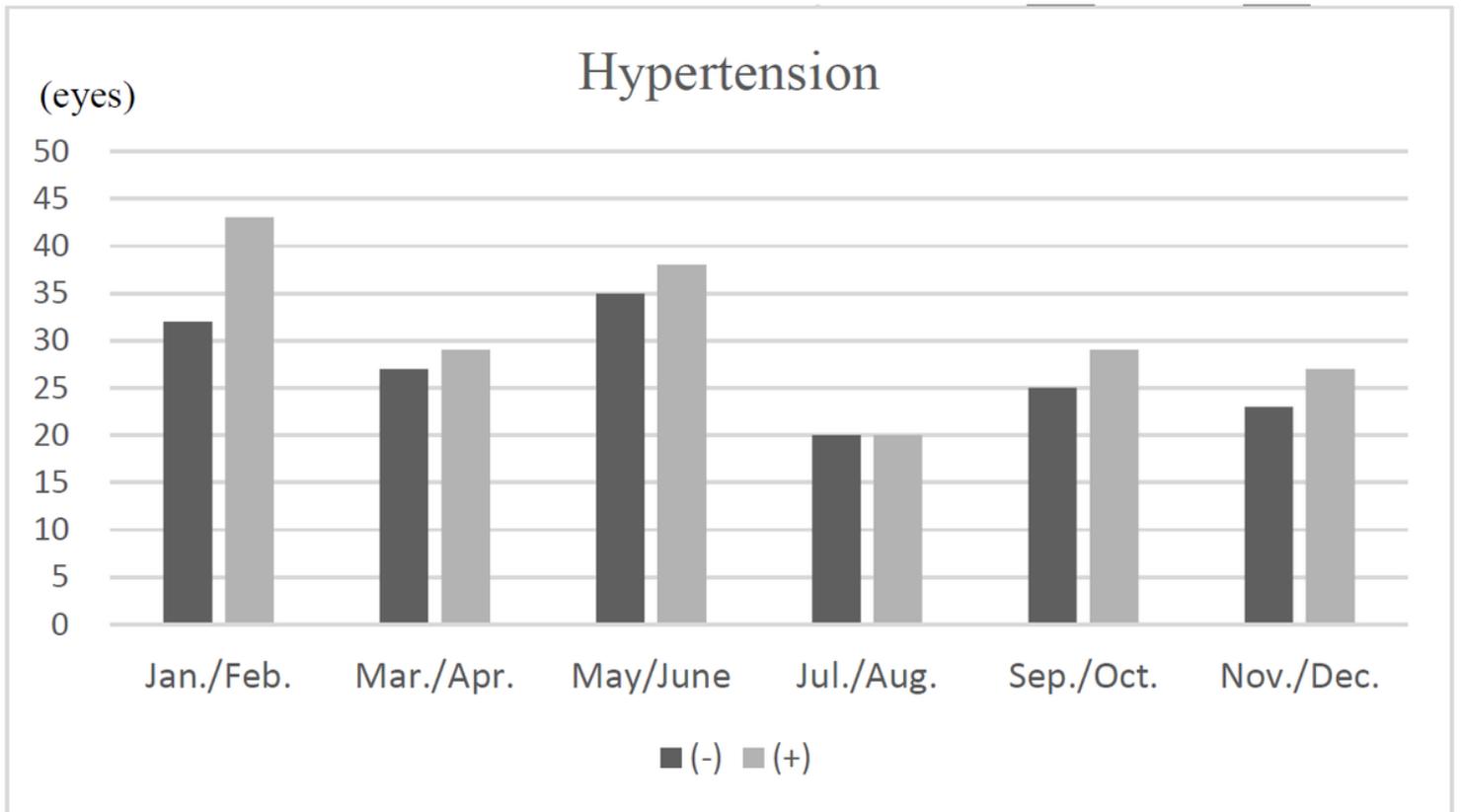


Figure 2

Retinal vein occlusion onset periods, based on the patients being classified as not having (dark bars) or having (grey bars) hypertension.

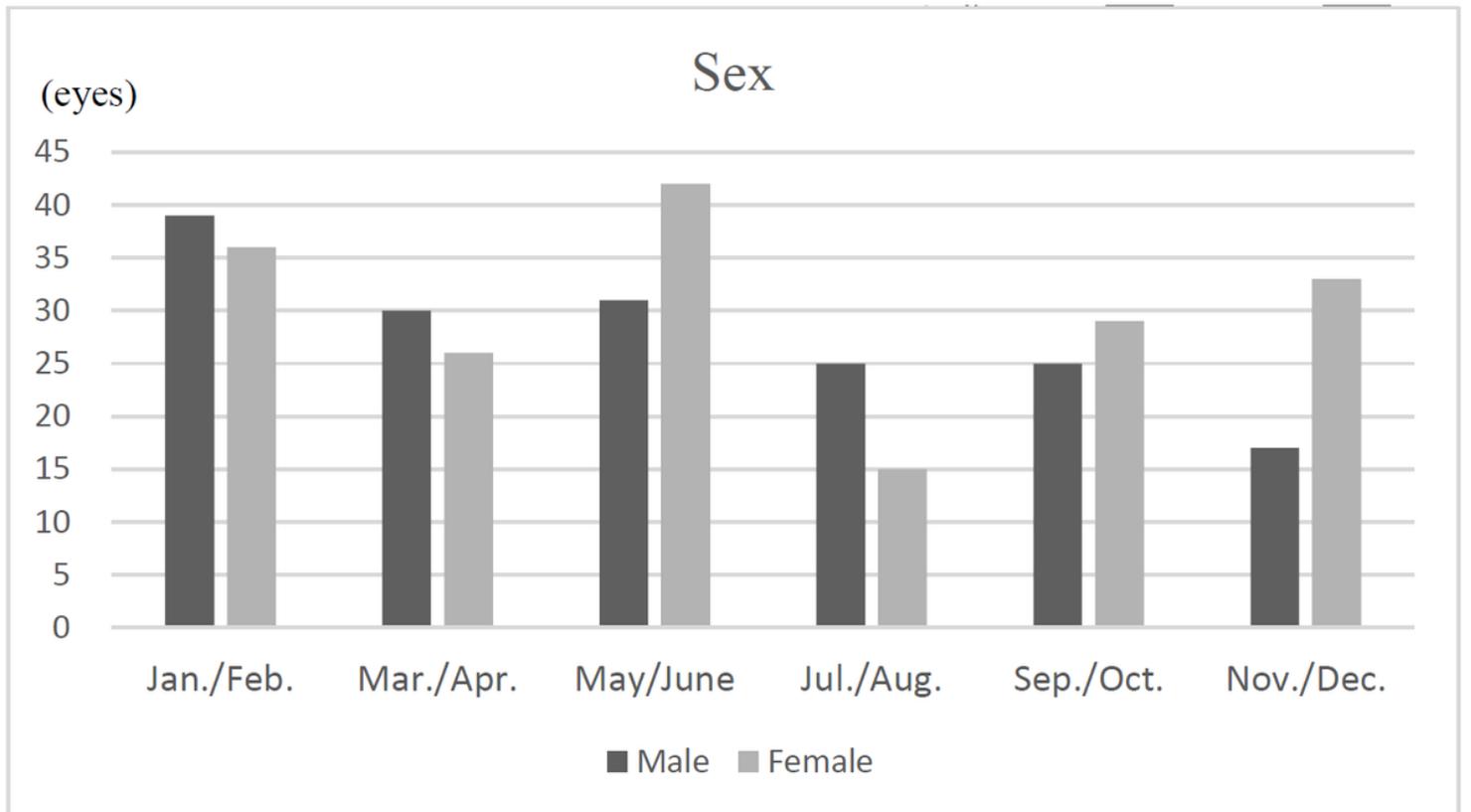


Figure 3

Retinal vein occlusion onset periods, with patients classified by sex (dark bars for males, grey bars for females).

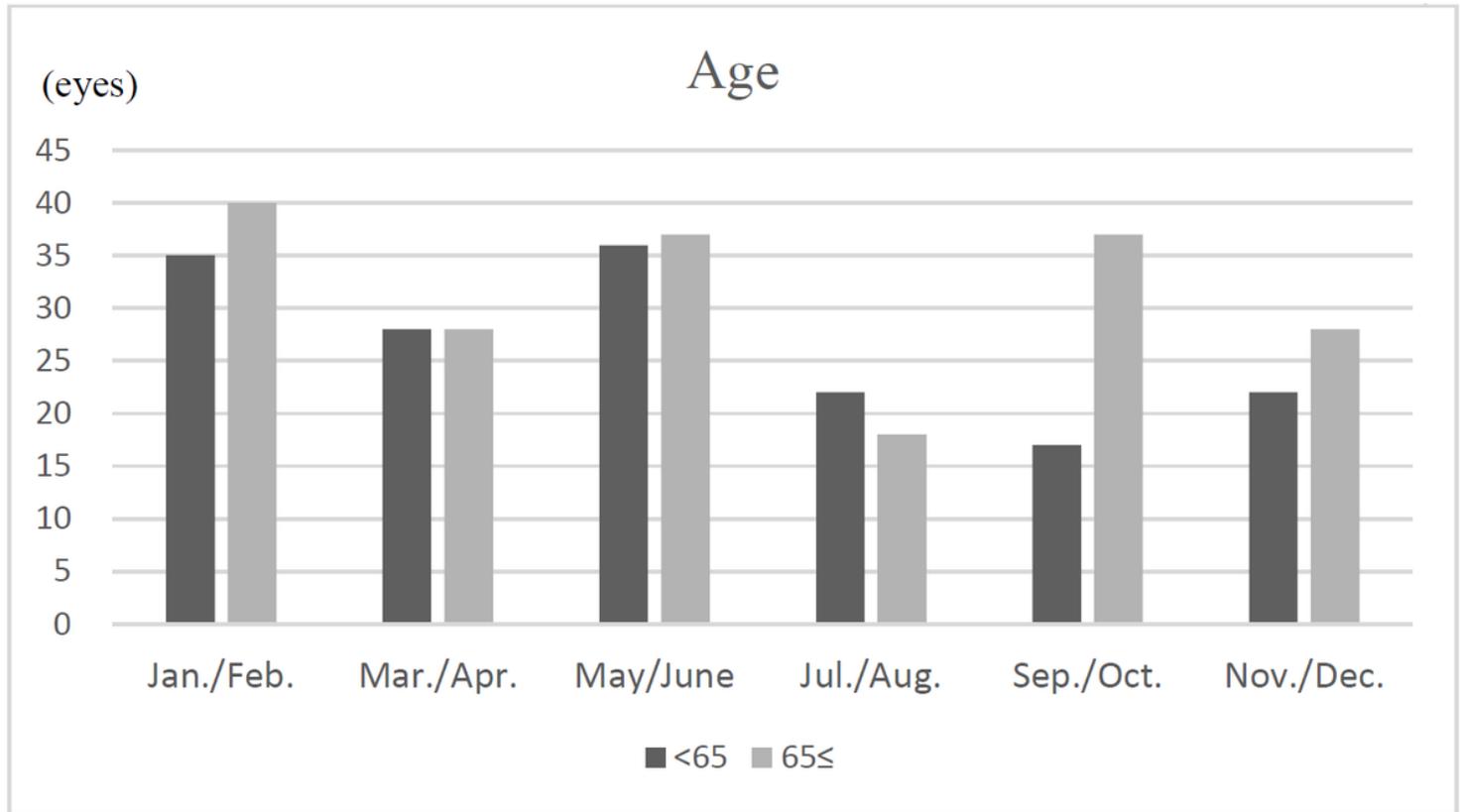


Figure 4

Retinal vein occlusion onset periods, with patients classified by age (dark bars for <65-years-old, grey bars for ≥ 65-years-old).

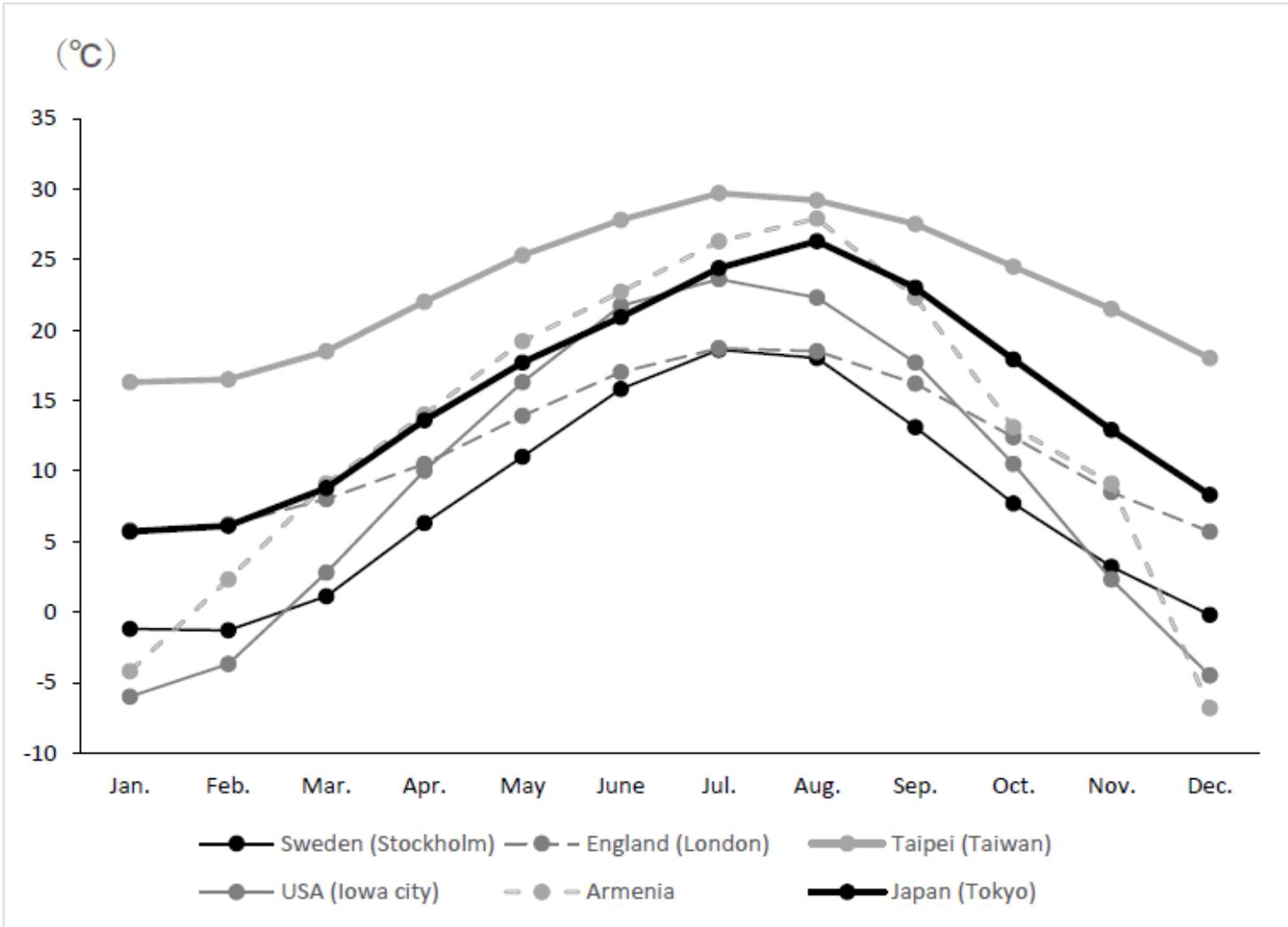


Figure 5

Average annual temperatures at the study locations mentioned in the text [18].