Prevalence and Associations of Asteroid Hyalosis: The Beijing Eye Study

Chuan Zhang

Beijing Tongren Hospital

Lei Shao

Beijing Tongren Hospital

Li Dong

Beijing Tongren Hospital

Wen Da Zhou

Beijing Tongren Hospital

Rui Zhang

Beijing Tongren Hospital

Wen Bin Wei (✉ weiwenbintr@163.com)

Beijing Tongren Hospital

Research Article

Keywords: Asteroid Hyalosis, Prevalence, Associations, Beijing Eye Study

Posted Date: October 19th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-965583/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: To determine the prevalence and associations of asteroid hyalosis (AH) in a Chinese population-based cohort.

Methods: The population-based Beijing Eye Study 2011 included 3468 individuals with a mean age of 64.6 ± 9.8 years (range: 50-93 years). AH is a condition in which small yellow-white, spherical particles known as asteroid bodies (ABs) are present within the vitreous body.

Results: Fundus photographs were gradable in 3419 subjects. AH was detected in 65 (0.9%, 95% CI: 0.7%, 1.2%) eyes of 53 (1.5%, 95% CI: 1.1%, 1.9%) subjects. AH was bilateral in 18.9%. Mean age of all subjects with AH was 69.2 ± 9.5 years (median, 71.0 years; range, 51–91 years), mean refractive error was 0.63 ± 1.53 D (median, 0.75 D; range, -4.12 to 4.00 D). In multivariate analysis, prevalence of AH was associated with elder age ($P=0.014$, OR 1.057), thicker lens ($P=0.034$, OR 3.843), higher refractive error ($P=0.016$, OR 1.401).

Conclusions: In adult Chinese in Beijing, the prevalence of AH was 0.9% for eyes or 1.5% for subjects. AH was associated with elder age, thicker lens and higher refractive error. It does not support previous observations of an association of AH with diabetes or other systemic indicators.

Introduction

Asteroid hyalosis (AH) is a condition in which small yellow-white, spherical particles known as asteroid bodies (ABs) are distributed throughout the vitreous either randomly or in chains or sheets. ABs, which are composed of lipids complexed with calcium, phosphates, and oxygen¹, have a smooth spherical morphology and moves with the displacement of the vitreous during head or eye movement. AH generally only has a minor impact on vision² and thus does not generally require intervention.

Earlier reports have associated AH with systemic conditions, including diabetes^{3,4}, hyperlipidemia^{5,6}, hypercholesterolemia⁶, and hypertension³. There has been no population-based investigation on the occurrence and associations of AH with other ocular and general parameters in Chinese population. We therefore conducted the present study to describe the prevalence of AH in a representative older Chinese population and to investigate systemic and ocular associations, both previously reported and unreported.

Methods

Ethics Statement

The Medical Ethics Committee of the Beijing Tongren Hospital approved the study protocol and all participants gave informed written consent, according to the Declaration of Helsinki.

The Beijing Eye Study 2011 is a population-based cross-sectional study in Beijing, China. The only eligibility criterion for inclusion into the study was an age of over 50 years. In 2011, it had a total population of 4403 individuals aged 50 years or older. In total, 3468 individuals (1963 (56.6%) women) participated in the eye examination, corresponding to an overall response rate of 78.8%. The mean age of subjects was 64.6 ± 9.8 years (median, 64 years; range, 50 - 93 years).

Information on demographic variables, socioeconomic background, and known major systemic diseases were collected. Fasting blood samples were taken for measurement of blood lipids, glucose and glycosylated hemoglobin HbA1c. Blood pressure was measured. Body height and weight and the circumference of the waist and hip were recorded. All subjects underwent comprehensive ophthalmological examination, before and after pupil dilatation. Visual acuity (VA), best corrected VA (Auto Refractometer AR-610, Nidek Co., Ltd, Tokyo, Japan), Intraocular pressure (IOP, Goldmann tonometer), slit lamp examination were recorded. The anterior segment (Lenstar 900® Optical Biometer, Haag-Streit, 3098 Koeniz, Switzerland), fundus examination (spectral-domain OCT, Optovue Inc. Fremont, CA, U.S.A.; Spectralis, Heidelberg Engineering, Heidelberg, Germany) were performed. The study has been described in detail⁷.

The assessment included stereoscopic 30° retinal photographs, using a fundus camera (Type CR6-45NM, Canon Inc. U.S.A.) of multiple fields in both eyes. Signs of AH were recorded either from the presence of typical ABs seen at the slit-lamp or on retinal examination or from the stereo fundus images. The images were taken by one technician (CXC) and the images were assessed by experienced and trained ophthalmologists (CZ, LS). In case of doubt, the fundus images were reassessed by a panel including several ophthalmologists (LS, WBW).

The statistical analysis was performed using a commercially available statistical software package (SPSS for Windows, version 25.0, SPSS, Chicago, IL, USA). The prevalence of AH was calculated. And we performed logistic regression analysis to assess associations with asteroid hyalosis. 95% Confidence intervals (CI) were presented. All *P*-values were 2-sided and were considered statistically significant when the values were less than 0.05.

Results

Of 3468 participants, 3419 had gradable fundus images. The mean age was 69.2 ± 9.5 years (median, 71.0 years; range, 51–91 years), the mean refractive error (spherical equivalent) was 0.63 ± 1.53 diopters(D) (median, 0.75 D; range, -4.12 to 4.00 D). Asteroid hyalosis was diagnosed in 65 eyes of 53 subjects, including 23 right, 22 left and 10 for both eyes. AH was detected in 65 (0.9%, 95% CI: 0.7%, 1.2%) eyes of 53 (1.5%, 95% CI: 1.1%, 1.9%) subjects. Prevalence increased significantly with age from 0.7% in the 50-59 year age group to 2.7% in the 80-93 year age group (Figure 1). AH was bilateral in 18.9% (10/53). The mean age of all subjects with AH was 69.2 ± 9.5 years (median, 71.0 years; range, 51–91 years), mean refractive error was 0.63 ± 1.53 D (median, 0.75 D; range, -4.12 to 4.00 D).

If in a bivariate analysis the subjects with AH were compared with the subjects without AH, the prevalence was significantly associated with the systemic parameters of elder age ($P=0.001$), and with the ocular parameters of higher refractive error ($P=0.0006$), thicker lens ($P<0.001$), larger pupil diameter ($P=0.039$). It was not significantly associated with the systemic parameters of body height ($P=0.566$), weight ($P=0.380$), diastolic blood pressure ($P=0.342$), systolic blood pressure ($P=0.780$), serum concentrations of low-density lipoproteins ($P=0.832$), high-density lipoproteins ($P=0.407$), cholesterol ($P=0.567$), creatine ($P=0.576$), triglycerides ($P=0.899$), glucose ($P=0.129$), hypertension ($P=0.366$), hyperlipidemia ($P=0.174$), diabetes mellitus ($P=0.780$), self-reported diagnosis of cerebral infarction or haemorrhage ($P=1.000$), and of coronary heart disease ($P=0.264$), frequency of reported snoring ($P=0.939$), smoking ($P=0.298$), drinking ($P=0.647$), with demographic and socioeconomic variables of rural region of habitation ($P=0.735$), cognitive level ($P=0.791$), and with the ocular parameters of anterior chamber depth ($P=0.075$), central corneal thickness ($P=0.285$), corneal diameter ($P=0.098$), corneal steep ($P=0.578$), best corrected visual acuity ($P=0.143$), posterior vitreous detachment (PVD) ($P=0.417$), subfoveal retinal thickness ($P=0.143$). (Table1)

Table 1
Factors Associated with Asteroid Hyalosis in the Beijing Eye
Study (Univariate analysis).

Factor	P-value	t/ χ^2
Gender	0.263	1.120
Age	0.001*	-3.389
Region of habitation	0.735	0.583
Body height	0.566	0.574
Body weight	0.380	0.879
Cognitive level	0.791	0.597
Diastolic blood pressure	0.342	0.951
Systolic blood pressure	0.780	-0.280
Low-density lipoproteins	0.832	0.212
High-density lipoproteins	0.407	0.830
Cholesterol	0.567	0.573
Creatinine	0.576	-0.559
Triglycerides	0.899	0.127
Glucose	0.129	-1.553
Known diabetes mellitus	0.780	0.078
Known coronary heart disease	0.264	1.249
Known Hypertension	0.366	0.816
Known hyperlipidemia	0.174	3.502
Cerebral infarction or haemorrhage	1.000	0.073
Smoking	0.298	2.422
Alcohol consumption	0.647	3.569
Snoring	0.939	0.126
Refractive error	0.006*	-2.770
Anterior chamber depth	0.075	1.781
Lens thickness	0.000*	-4.934
Central corneal thickness	0.285	1.070

Factor	P-value	t/ χ^2
Corneal diameter	0.098	-1.655
Corneal steep	0.578	0.560
Pupil diameter	0.039*	2.065
Best corrected visual acuity(LogMAR)	0.143	1.485
Posterior vitreous detachment	0.417	0.659
Subfoveal retinal thickness	0.187	-1.321

In a multivariate logistic regression analysis (forward stepwise method), variables with $P < 0.01$ in univariate analysis (age, refractive error, lens thickness, pupil diameter ($P=0.05$), anterior chamber depth ($P=0.075$), corneal diameter ($P=0.098$)) and risk factors reported in previous studies (glucose ($P=0.129$), cholesterol ($P=0.567$), triglycerides ($P=0.899$)) were included. The prevalence of AH was no longer significantly associated with pupil diameter ($P=0.039$). The associations between the presence of AH and elder age ($P=0.014$, OR 1.057), thicker lens ($P=0.032$, OR 3.887), higher refractive error ($P=0.017$, OR 1.396), were statistically significant. The prevalence of AH was not significantly associated with the systemic parameters of glucose, cholesterol, triglycerides. (Table 2)

Table 2
Factors Associated with Asteroid Hyalosis using Multivariate Logistic Regression Models in the Beijing Eye Study.

Factor	P-value	OR	95% confidence interval	
Age	0.014	1.057	1.011,	1.105
Lens thickness	0.032	3.887	1.121,	13.476
Refractive error	0.017	1.396	1.062,	1.834

Discussion

In our population-based study on adult Chinese in Beijing, the prevalence of AH was 0.9% per eye or 1.5% per subject. AH was associated with elder age ($P=0.014$, OR 1.057), thicker lens ($P=0.032$, OR 3.887), higher refractive error ($P=0.017$, OR 1.396). AH was not associated with the systemic parameters of blood pressure, glucose, diabetes, cholesterol, triglycerides.

Previous studies of the prevalence of AH were in autopsy series and clinical populations.⁸ However, the best source for prevalence estimates in a general population is population-based studies. To our knowledge, this is the first large population-based study reporting on the prevalence of AH in Asian populations. Our prevalence (1.5%, 95% CI: 1.1 to 1.9%) results are consistent with previous studies of AH.⁹ In the Beaver Dam Eye Study¹⁰ of 4,952 patients, AH was present in 1.2% (95% CI: 0.9 to 1.5%) of the

total population. The Australian Blue Mountains Eye Study¹¹ of 3,654 patients confirmed a similar 1.0% (95% CI:0.7 to 1.3%) prevalence of AH. In the autopsy series of 10,801 eyes studied at UCLA¹², AH had a prevalence of 1.96%.

Our data show that AH was associated with elder age ($P=0.014$). Prevalence increased significantly with age from 0.7% in the 50-59 year age group to 2.7% in the 80-93 year age group. Several clinical-based studies^{10,12,13} concluded that the occurrence of AH was significantly associated with elder age. In the Beaver Dam Eye Study¹⁰, the prevalence of AH increasing from 0% of persons aged less than 55 years to 2.1% of persons aged 75 years or older. In the Australian Blue Mountains Eye Study¹¹, the prevalence of AH also increased with age from 0.2% in subjects 43-54 years, to 2.9% in subjects 75-86 years. These findings confirm our results. Komatsu and coworkers¹⁴ used samples of AH obtained in vitreous surgery and observed with light and electron microscopes and processed by the focused ion-beam method. They thus concluded that AH was produced not only by changing of ionic tension in the vitreous fluid but also by changes of vitreous matrix in the aging process and diseases.

Our data also show that AH was associated with higher refractive error ($P=0.017$). Bergren³ and coworkers performed a cross-sectional study of 12,205 patients and reported patients with AH were more hyperopic than control subjects. One explanation is that the complete posterior vitreoretinal interface may be important for the formation of asteroid zona pellucida¹⁵. Therefore, the older the age, the more likely the individuals who maintain posterior vitreous attachment are to develop AH. This may explain why AH is associated with higher refractive error, because PVD is more common in myopia and occurs at an earlier age¹⁶. However, we did not find the association between AH and PVD($P=0.417$) in our study, which may due to the lack of statistics on complete or partial PVD. Another possibility is that, the presence of AH may arrest the process of vitreous collapse or contraction and has a protective effect on vitreous liquefaction¹⁷, which prevents PVD.

In our population-based study, AH also correlated to the thicker lens ($P=0.032$). As there is no relevant report so far, the associations between AH and lens thickness have remained unclear. One of the reasons may be that the lens thickness was associated with higher age and hyperopic refractive error¹⁸. Previous studies¹⁹ have proved that the age-related increase in lens thickness was due to the continuous production of new lens fibers in the equatorial region of the lens. Besides, the higher refractive power necessary in hyperopic eyes lead to greater lens thickness¹⁹. From a geometric point of view, the thicker lens partially protrudes forward into the anterior chamber and partially bulged backward into the vitreous cavity, which may affect the dynamics of aqueous humor circulation²⁰ and thus cause changes in the composition of vitreous extracellular matrix.

In our study, AH was not associated with systemic parameters of body height ($P=0.566$), weight ($P=0.380$), diastolic blood pressure ($P=0.342$), systolic blood pressure ($P=0.780$), serum concentrations of low-density lipoproteins($P=0.832$), high-density lipoproteins ($P=0.407$), cholesterol ($P=0.567$), creatine($P=0.576$),triglycerides ($P=0.899$), glucose ($P=0.129$), hypertension ($P=0.366$), hyperlipidemia

($P=0.174$), diabetes mellitus ($P=0.780$), self-reported diagnosis of cerebral infarction or haemorrhage ($P=1.000$), and of coronary heart disease ($P=0.264$), frequency of reported snoring ($P=0.939$), smoking ($P=0.298$), drinking ($P=0.647$). AH has purportedly been associated with several systemic diseases, including diabetes⁵, hypercholesterolemia⁵, hypertension³, hypercalcemia²¹ and gout¹³. Many of these studies have been case series, case-control studies, or performed in clinic populations and may reveal a selection bias for diseases that are more prevalent in patients presenting for ophthalmic and vitreoretinal evaluations. Thus, these findings cannot readily be extrapolated to the general population. Besides, the prevalence of bilateral AH was 18.9% in our study. The fact that AH mainly occurs unilaterally^{3,10-12} does not support an association with systemic parameters.

The findings in our study may have clinical importance, since AH may prevent PVD and have a protective effect¹⁷ on vitreomacular traction. Besides, AH generally only has a minor impact on vision and thus may be a useful model for better understanding the interaction between incident light and intravitreal structures. Further studies may assess whether the results of our study help in understanding the pathogenesis of these disorders by showing the correlations of AH and other ocular and general parameters.

This is the first population-based investigation searching for the prevalence and associations between ocular and systemic parameters and AH in the Asian population. Despite the advantages of this population-based study, potential limitations of our study should be mentioned. First, a major concern regarding any prevalence study is non-participation. The Beijing Eye Study 2011 had a reasonable response rate of 78.8%, although differences between participants and non-participants can lead to a selection bias. Second, the presence of AH was determined either from the presence of typical ABs seen at the slit-lamp or on retinal examination or from the stereo fundus images of a limited number of fields. ABs may present only in peripheral areas and not be detected. Thus, we are probably underestimating the prevalence of AH. Another limitation is the cross-sectional design of the study. This prevents us from knowing the antecedent-consequent relationship between the risk factors and the endpoint.

In conclusion, in adult Chinese in Beijing, the prevalence of AH was 0.9% for eyes or 1.5% for subjects. While it was associated with elder age, thicker lens and higher refractive error.

Declarations

FUNDING

This study was supported by National Natural Science Foundation of China (82000916); the priming scientific research foundation for the junior researcher in Beijing Tongren Hospital, Capital Medical University (2016-YJJ-ZLL-009); Beijing Hospitals Authority Youth Programme (QML20180204); the priming scientific research foundation for the junior researcher in Beijing Tongren Hospital, Capital Medical University (No.2018-YJJ-ZZL-045). Dongcheng District Outstanding Talent Nurturing Program (2020-dchrcpyzz-42).

AUTHOR CONTRIBUTIONS

Design of the study: Shao L, Wei WB; development of the algorithm: Zhang C; gathering the data: Zhang C; Shao L, Dong L, Zhou WD, Zhang RH; performing the data analysis: Zhang C; drafting the first version of the manuscript: Zhang C; revision and approval of the manuscript: all authors.

ACKNOWLEDGEMENTS

The authors declare that the research was conducted in the absence of any financial and non-financial relationships that could be construed as a potential conflict of interest.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the correspondence authors to any qualified researcher with appropriate requests.

Competing Interest: The authors have declared that no financial and non-financial interests exist.

References

1. Winkler, J. & Lünsdorf, H. Ultrastructure and composition of asteroid bodies. *Investigative ophthalmology & visual science*, **42**, 902–907 (2001).
2. Kim, J. H. *et al.* Prevalence of and risk factors for asteroid hyalosis in Seoul, Korea. *Retina (Philadelphia, Pa.)*, **28**, 1515–1521 <https://doi.org/10.1097/IAE.0b013e318185ea3c> (2008).
3. Bergren, R. L., Brown, G. C. & Duker, J. S. Prevalence and association of asteroid hyalosis with systemic diseases. *American journal of ophthalmology*, **111**, 289–293 [https://doi.org/10.1016/s0002-9394\(14\)72311-6](https://doi.org/10.1016/s0002-9394(14)72311-6) (1991).
4. Elbaz, H. *et al.* Epidemiologic Analysis of Asteroid Hyalosis and Associations: The Gutenberg Health Study., **128**, 328–330 <https://doi.org/10.1016/j.ophtla.2020.07.008> (2021).
5. Smith, J. L. Asteroid hyalitis: incidence of diabetes mellitus and hypercholesteremia. *J Am Med Assoc*, **168**, 891–893 <https://doi.org/10.1001/jama.1958.63000070002010a> (1958).
6. Bard, L. A., ASTEROID & HYALITIS: RELATIONSHIP TO DIABETES AND HYPERCHOLESTEROLEMIA. *American journal of ophthalmology*, **58**, 239–242 (1964).
7. Shao, L. *et al.* Visual acuity and subfoveal choroidal thickness: the Beijing Eye Study. *American journal of ophthalmology*, **158**, 702 <https://doi.org/709.e701> (2014).
8. Khoshnevis, M., Rosen, S. & Sebag, J. Asteroid hyalosis-a comprehensive review. *Surv Ophthalmol*, **64**, 452–462 <https://doi.org/10.1016/j.survophthal.2019.01.008> (2019).
9. Møller-Lorentzen, T. B., Eckmann-Hansen, C., Faber, C., Larsen, M. & Subhi, Y. Global prevalence of asteroid hyalosis and projection of its future burden: a systematic review and meta-analysis. *Acta*

- ophthalmologica*, **98**, 755–762 <https://doi.org/10.1111/aos.14465> (2020).
10. Moss, S. E., Klein, R. & Klein, B. E. Asteroid hyalosis in a population: the Beaver Dam eye study. *American journal of ophthalmology*, **132**, 70–75 [https://doi.org/10.1016/s0002-9394\(01\)00936-9](https://doi.org/10.1016/s0002-9394(01)00936-9) (2001).
 11. Mitchell, P., Wang, M. Y. & Wang, J. J. Asteroid hyalosis in an older population: the Blue Mountains Eye Study. *Ophthalmic Epidemiol*, **10**, 331–335 <https://doi.org/10.1076/oep.10.5.331.17324> (2003).
 12. Fawzi, A. A. *et al.* Asteroid hyalosis in an autopsy population: The University of California at Los Angeles (UCLA) experience. *Archives of ophthalmology (Chicago, Ill.: 1960)* **123**, 486-490, doi:10.1001/archopht.123.4.486 (2005).
 13. Safir, A., Dunn, S. N., Martin, R. G., Tate, G. W. & Mincey, G. J. Is asteroid hyalosis ocular gout? *Ann Ophthalmol*, **22**, 70–77 (1990).
 14. Komatsu, H., Kamura, Y., Ishi, K. & Kashima, Y. Fine structure and morphogenesis of asteroid hyalosis. *Med Electron Microsc*, **36**, 112–119 <https://doi.org/10.1007/s00795-002-0211-y> (2003).
 15. Wasano, T., Hirokawa, H., Tagawa, H., Trempe, C. L. & Buzney, S. M. Asteroid hyalosis: posterior vitreous detachment and diabetic retinopathy. *Ann Ophthalmol*, **19**, 255–258 (1987).
 16. Hayashi, K., Manabe, S. I., Hirata, A. & Yoshimura, K. Posterior Vitreous Detachment in Highly Myopic Patients. *Investigative ophthalmology & visual science*, **61**, 33 <https://doi.org/10.1167/iovs.61.4.33> (2020).
 17. Topilow, H. W. *et al.* Asteroid hyalosis. Biomicroscopy, ultrastructure, and composition. *Archives of ophthalmology (Chicago, Ill.: 1960)* **100**, 964-968, doi:10.1001/archopht.1982.01030030972015 (1982).
 18. Jonas, J. B., Nangia, V., Gupta, R., Sinha, A. & Bhate, K. Lens thickness and associated factors. *Clin Exp Ophthalmol*, **40**, 583–590 <https://doi.org/10.1111/j.1442-9071.2012.02760.x> (2012).
 19. Warrier, S. *et al.* Ocular biometry and determinants of refractive error in rural Myanmar: the Meiktila Eye Study. *The British Journal of Ophthalmology*, **92**, 1591–1594 <https://doi.org/10.1136/bjo.2008.144477> (2008).
 20. Mark, H. H. Aqueous humor dynamics in historical perspective. *Surv Ophthalmol*, **55**, 89–100 <https://doi.org/10.1016/j.survophthal.2009.06.005> (2010).
 21. Jervey, E. D. & Anderson, W. B. Jr. ASTEROID HYALITIS: A STUDY OF SERUM CALCIUM LEVELS IN AFFECTED PATIENTS. *South Med J*, **58**, 191–194 <https://doi.org/10.1097/00007611-196502000-00010> (1965).

Figures

Figure 1

Prevalence of asteroid hyalosis by age and sex groups in Beijing Eye Study 2011.