Ocular findings in a population of geriatric equids in the United Kingdom

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Ocular findings in a population of geriatric equids in the United Kingdom

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Abstract

Background: There are a growing number of horses, ponies, and donkeys aged 15 years or older in the United Kingdom, yet there have been no studies utilising a complete ophthalmic examination to investigate the prevalence of ophthalmic pathology within this population.

Objectives: To investigate the prevalence of ophthalmic pathology and associations with signalment, in a convenience sample of geriatric equids in the United Kingdom.

Study design: Cross sectional.

Methods: Horses, ponies, and donkeys aged 15 years or older based at The Horse Trust charity underwent a full ophthalmic examination including slit lamp biomicroscopy and indirect ophthalmoscopy. Relationships between signalment and pathology were assessed using Fisher's exact and Mann–Witney *U* tests.

Results: Fifty animals were examined ranging from 15 to 33 years (median 24, interquartile range [IQR] 21, 27). The prevalence of ocular pathology was 84.0% (95% confidence interval [CI] 73.8, 94.2%; $n = 42$). Four animals (8.0%) had adnexal pathology, while 37 (74.0%) and 22 (44.0%) had at least one form of anterior or posterior segment pathology, respectively. Of those with anterior segment pathology, 26 animals (52.0%) had cataract in at least one eye, with the most common location being anterior cortical (65.0% of those animals with cataract). Animals with posterior segment pathology included 21 animals (42.0%) with fundic pathology, with senile retinopathy being the most common (42.9% of all animals with fundic pathology). Despite the high prevalence of ocular pathology, all eyes examined remained visual. The most common breeds were Irish Draught (24.0%, $n = 12$), Shetland (18.0%, $n = 9$) and Thoroughbred (10%, $n = 5$); the majority were geldings (74.0%, $n = 37$). There was a statistically significant relationship between the presence of anterior segment pathology and breed ($p = 0.006$), with all Cobs and Shetlands examined having anterior segment pathology. The presence of posterior segment pathology and senile retinopathy were associated with older median age (posterior segment pathology: 26.0 years [interquartile range {IQR}

24.0, 30.0 years] vs. 23.5 years [IRQ 19.5, 26.5 years], $p = 0.03$; senile retinopathy: 27.0 years [IQR 26.0, 30 years] vs. 24.0 years [IQR 20.0, 27.0], $p = 0.04$). None of the pathologies investigated were more prone to affect one versus both eyes ($p > 0.05$; 71.4% of ocular pathologies were bilateral while 28.6% were unilateral).

Main limitations: Data were obtained from a relatively small sample size of a single cohort of animals that lacked a control group.

Conclusions: There was a high prevalence and wide range of ocular lesions in this subset of geriatric equids.

KEYWORDS
disease prevalence, geriatric, horse, ophthalmology

1 | INTRODUCTION

There are a growing number of horses, ponies, and donkeys aged 15 years or older in the United Kingdom, probably owing in part to our improved knowledge of preventative and therapeutic equine medicine.[1] In humans, an increasing ageing population has seen the prevalence of age-related ocular conditions such as macular degeneration, cataracts, glaucoma, asteroid hyalosis, and certain retinopathies also increase.[2] Knowing whether this is the case for equids is essential to provide adequate preventive, therapeutic and husbandry measures to maximise their ocular health, welfare, and careers.

In 2003 Chandler et al.[3] reported the findings of ocular examinations performed on 83 geriatric horses in the United Kingdom. Using direct ophthalmoscopy alone (and pharmacological pupillary dilation when needed), they found a high prevalence of ophthalmic lesions, with vitreal degeneration and senile retinopathy being the most prevalent. In 2012 Ireland et al.[4] reported the examination findings of 200 geriatric horses in the United Kingdom, with 94% of horses having at least one form of ocular pathology. However, ophthalmic examination consisted only of direct and indirect ophthalmoscopy and did not utilise pharmacological pupillary dilation. In 2019 Malalana et al.[5] reported the ophthalmic findings of 327 horses aged 15 years or older in Australia, concluding that increasing age was associated with increased odds of the presence of cataracts. Although pharmacological pupillary dilation was performed, only direct and indirect ophthalmoscopy were used to perform the examinations. Furthermore, as previous studies have shown that geographical location and increasing ultraviolet (UV) radiation exposure can increase the prevalence of certain ophthalmic conditions, extrapolation of these results to the UK population may not be appropriate.[6–10]

Therefore, we aimed to perform a study led by board-certified veterinary ophthalmologists utilising a complete ophthalmic examination (including slit-lamp biomicroscopy and indirect ophthalmoscopy) to investigate the prevalence of ophthalmic lesions in geriatric equids in the United Kingdom.

2 | MATERIALS AND METHODS

2.1 | Animals

All horses, ponies, and donkeys aged 15 years or older, based at The Horse Trust charity, Princes Risborough, UK, were examined over a 2-day period in December 2021. All horses were born in the United Kingdom. The population consisted of a mixture of retired service animals (e.g., ex-military, mounted police, Royal Mews carriage horses) and rescue animals.

2.2 | Examination protocol

Ophthalmic examinations were performed in a darkened stable or examination room by one of two European College of Veterinary Ophthalmologists (ECVO) board-certified ophthalmologists or one of three ECVO residents under the direct supervision of a board-certified ophthalmologist. Prior to examination, yard staff working closely with each animal were asked whether they perceived the animal to have any visual deficits based on their behaviour.

A full ophthalmic examination was performed, including neuro-ophthalmology testing (menace response assessment, and palpebral, dazzle, and PLR assessment), slit-lamp biomicroscopy (Kowa SL-17 Slit-lamp, Kowa Co.), indirect ophthalmoscopy (Heine Omega 500 Binocular Indirect Ophthalmoscope, Heine Optotechnik) with a 30 diopter or Pan Retinal 2.2 condensing lens (Volk Optical), and direct ophthalmoscopy (Heine BETA 2000, Heine Optotechnik). Tear production was assessed in both eyes using the Schirmer tear test-1 (STT; Schering-Plough Animal Health), and intraocular pressure (IOP) measured with rebound tonometry (TonoVet, iCare) if tolerated. Pharmacological mydriasis was achieved with topical 1% tropicamide (Minims, Bausch & Lomb, UK) in cases that were found to have lens or fundus pathology on initial examination. External (Canon 90D with 60 mm Canon macro lens and Canon Macro TwinLite flash) and retinal (RetCam Envision, Clarity Medical Systems, Inc.) photographs were obtained if pathology was seen.

Where possible, horses were examined without sedation. Intravenous sedation was administered if pathological lesions were identified upon initial examination without sedation, but was considered necessary to allow a safe, thorough examination to fully characterise any pathology seen. Sedation was administered as per the attending veterinarian's clinical judgement, but typically with 0.01 mg/kg detomidine HCl (Domidine, Dechra) and 0.01 mg/kg butorphanol HCl (Chanelle Pharma). Regional nerve blocks were not performed as they were not deemed necessary to allow for a full examination.

Abnormalities were considered pathological if they could not be attributed to normal, age-related changes based on the clinical judgement of a board-certified veterinary ophthalmologist. Pathology was considered vision-threatening if there was a reduction or absence of the menace response or an opacity within the ocular media that precluded detailed fundoscopic examination.

2.3 | Data analysis

Clinical data were managed in Microsoft Excel (Microsoft Corporation) and descriptive and inferential statistical analysis performed using Stata (IC v.13.0, StataCorp LP). The distribution of horse age, IOP and tear production via the STT-1 were assessed for normality visually using a histogram overlaid with a kernel density plot and formally using a Shapiro–Wilk test for normality.

Horse age, IOP and tear production via the STT-1 were described using medians with corresponding interquartile range (IQR) and range. The remainder of the variables were all categorical and were described as proportions (%) with 95% confidence intervals (CI). Categorical variables relating to signalment included breed category and sex (mare or gelding).

The overall prevalence of any ocular pathology in at least one eye found after full ophthalmic examination was estimated including 95% CI. Categorical variables relating to pathologies found after ophthalmic examination included whether any visual deficits were noted by the horse's usual caretaker (yes or no), the laterality of the pathology (unilateral or bilateral) and the presence or absence of pathology, including adnexal, corneal, anterior segment, posterior segment and fundus pathologies, cataracts or senile retinopathy.

Associations between horse age and pathology type were assessed using the Mann–Whitney *U* test while associations between horse breed, sex and pathology type were assessed using Fisher's exact test. The association between laterality and pathology type was assessed using Fisher's exact test. Significance was set at $p < 0.05$ and due to the relatively small sample size *p*-values were not adjusted for multiple comparisons.[11]

3 | RESULTS

A description of the main variables examined in the study is available in Tables 1 and 2.

A total of 50 animals were examined ranging from 15 to 33 years (median 24 years, IQR 21, 27).

All eyes examined were visual (as assessed by the menace response) including four animals that were suspected to have visual deficits by yard staff working closely with them, based on their behaviour. One horse had previously undergone a unilateral enucleation for unknown reasons. No animal had what was considered an immediately vision-threatening disease. Only eight animals (14 eyes) tolerated tonometry without sedation, with the median IOP of all eyes being 21.2 mmHg (IQR 16.6, 23.8, range 11, 29 mmHg).

A total of 45 animals (89 eyes) tolerated STT strip placement for the full 60 s in at least one eye. Four animals had readings that exceeded the maximum wetting level of the strips (35 mm), and the strip was removed from the eye at this point (these readings were recorded as 35 mm/min for statistical analysis). The median STT-1 reading was 24 and 23 mm/min for the right and left eyes, respectively, with a range of 10–35 mm/min, which were considered normal based on published reference ranges of 11 to >30 mm/min.[12]

One horse had a left-sided facial twitch; displaying irregular, asynchronous spasms affecting the left side of the face and eyelids which reportedly developed following a colic episode 2 years prior. The horse was otherwise healthy. Further investigations had not been pursued.

All animals had evidence of vitreal degeneration/liquefaction (syneresis), as seen by the presence of fine, cloudy, linear strands which followed the movement of the eye upon slit-lamp biomicroscopy. Likewise, all animals had nuclear sclerosis, as seen by clouding of the lens which did not interfere with funduscopic examination.

Overall, 84.0% ($n = 42$) of animals had at least one form of ocular pathology in at least one eye, with 60% ($n = 30$) of horses having abnormalities in both eyes. One or more type of adnexal pathology was present in four animals: an eyelid margin scar (two horses, two eyes), periocular alopecia and lichenification (one horse, one eye), a linear limbal/conjunctival scar (one horse, one eye), a proliferative conjunctival lesion (one horse, one eye), and a small eyelid mass (one horse, one eye) (Figure 1).

A total of 74.0% ($n = 37$) of animals had one or more type of anterior segment pathology, compared with 44.0% ($n = 22$) that had one or more type of posterior segment pathology. Anterior segment pathology included corneal, iris and lenticular changes. Five animals had corneal pathology, including punctate keratopathy (two horses, three eyes) (Figure 2), a focal area of sub-epithelial fibrosis (one horse, one eye) (Figure 2), axial corneal oedema (one horse, two eyes) (Figure 2), and one horse was found to have superficial corneal neovascularisation (one horse, two eyes). Iris pathology identified consisted of iris–iris persistent pupillary membranes (PPMs) (six animals, 10 eyes) (Figure 3), focal hypo/hyperpigmentation (six animals, seven eyes) (Figure 3), cystic granula iridica (three animals, three eyes) (Figure 3), avulsed granula iridica (one animal, one eye), and atrophied dorsal granula iridica (one animal, one eye).

A total of 52.0% ($n = 26$) of animals had cataract in at least one eye, with the most common location being anterior cortical (65.0% of those animals with cataracts; $n = 17$). The remainder were posterior cortical (six animals, nine eyes), nuclear (four animals, seven eyes), posterior subcapsular, (three animals, four eyes),

TABLE 1 Signalment of horses examined.

Variable (number of horses)	Number of horses	Percent	95% confidence interval
Breed (n = 50)			
Cob	4	8.0%	0.5, 15.5%
Irish Draught	12	24.0%	12.2, 35.8%
Irish Sports Horse	4	8.0%	0.5, 15.5%
Shetland	9	18.0%	7.4, 28.6%
Thoroughbred	5	10.0%	1.7, 18.3%
Welsh	4	8.0%	0.5, 15.5%
Other[a]	12	24.0%	12.2, 35.4%
Sex (n = 50)			
Gelding	37	74.0%	61.8, 86.2%
Mare	13	26.0%	13.8, 38.2%

[a]Other breeds included: Welsh and Welsh crosses ($n = 4$), Shire ($n = 1$), Clydesdale cross ($n = 1$), Warmblood cross ($n = 1$), Appaloosa ($n = 1$), Donkey ($n = 1$), Cleveland Bay ($n = 1$) and Trotter ($n = 1$).

TABLE 2 Frequency of main classes of ophthalmic pathology identified.

Variable (number of horses)	Number of horses	Percentage	95% confidence interval
Abnormalities found on ophthalmic examination ($n = 50$)			
Yes	42	84.0%	73.8, 94.2%
No	8	16.0%	5.8, 26.2%
Adnexal pathology present ($n = 50$)			
Yes	4	8.0%	0.5, 15.5%
No	46	92.0%	84.5, 99.5%
Anterior segment pathology present ($n = 50$)			
Yes	37	74.0%	61.8, 86.2%
No	13	26.0%	13.8, 38.2%
Corneal pathology present ($n = 50$)			
Yes	5	10.0%	1.7, 18.3%
No	45	90.0%	81.7, 98.3%
Cataract present ($n = 50$)			
Yes	26	52.0%	38.2, 65.8%
No	24	48.0%	34.2, 61.8%
Posterior segment pathology present ($n = 50$)			
Yes	22	44.0%	30.2, 57.8%
No	28	56.0%	42.2, 69.8%
Fundus pathology present ($n = 50$)			
Yes	21	42.0%	28.3, 55.7%
No	29	58.0%	44.3, 71.7%
Senile retinopathy present ($n = 50$)			
Yes	9	18.0%	7.4, 28.6%
No	41	82.0%	71.4, 92.6%

posterior capsular (two animals, three eyes), anterior subcapsular (two animals, two eyes), perinuclear with cortical extensions (one animal, one eye), and one horse had perinuclear cataracts bilaterally (Figure 4). Cataracts did not significantly interfere with fundic examination in any case.

Posterior segment pathology consisted of vitreal and fundus changes. Overall, 42.0% ($n = 21$) of animals had fundic pathology in at least one eye, 42.9% (nine animals) of which had senile retinopathy (Figure 5), and 19.0% (four animals) bullet-hole chorioretinopathy. Various other fundic pathologies were identified in lower numbers, including unknown

FIGURE 1 Examples of adnexal pathology seen, including (A) unilateral periocular and facial alopecia and lichenification; (B) a lateral canthal mass; (C) a linear, fibrotic lesion involving the lateral limbus and conjunctiva, and (D) an area of conjunctiva with a proliferative cobblestone appearance.

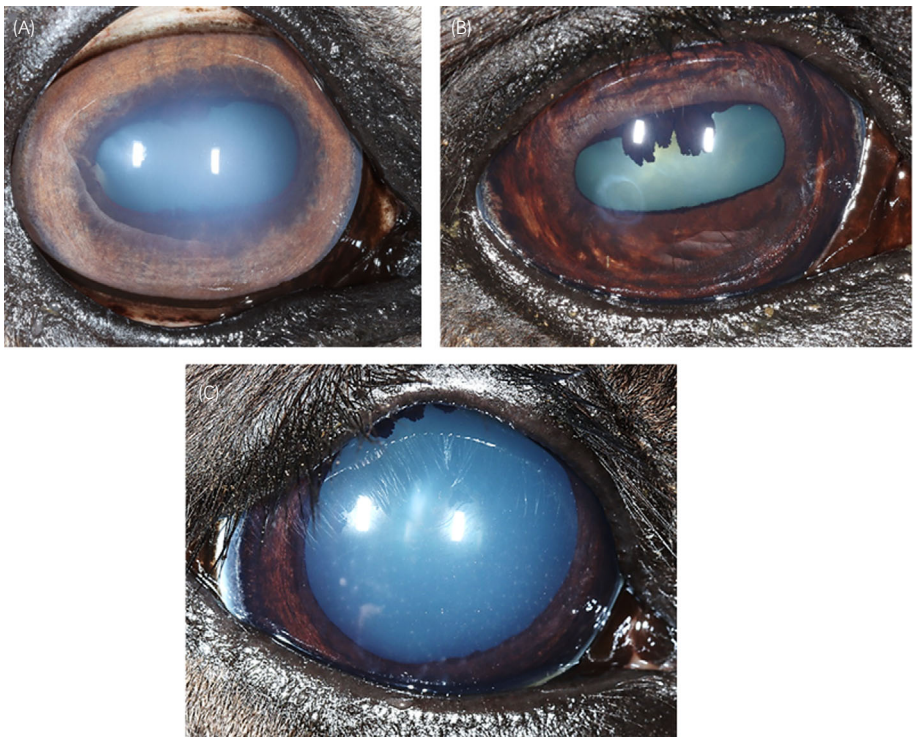

FIGURE 2 Examples of corneal pathology seen, including (A) bilateral corneal oedema; (B) a circular, focal area of sub-epithelial fibrosis, and (C) punctate keratopathy.

pigmentary disturbances (10 animals), retinal pigment epithelium (RPE) coloboma (two animals) (Figure 5), peripapillary hypopigmentation (two animals) (Figure 5), and proliferative optic nerve head lesions (two animals). Nine horses had more than one type of concurrent fundic pathology. A single horse had asteroid hyalosis in one eye.

Various associations between signalment and pathology were identified. A significant relationship was identified between the presence of anterior segment pathology and breed ($p = 0.006$). The proportion of horses with anterior segment pathology was highest in Cobs (100.0%) and Shetlands (100.0%) and lowest in Thoroughbreds

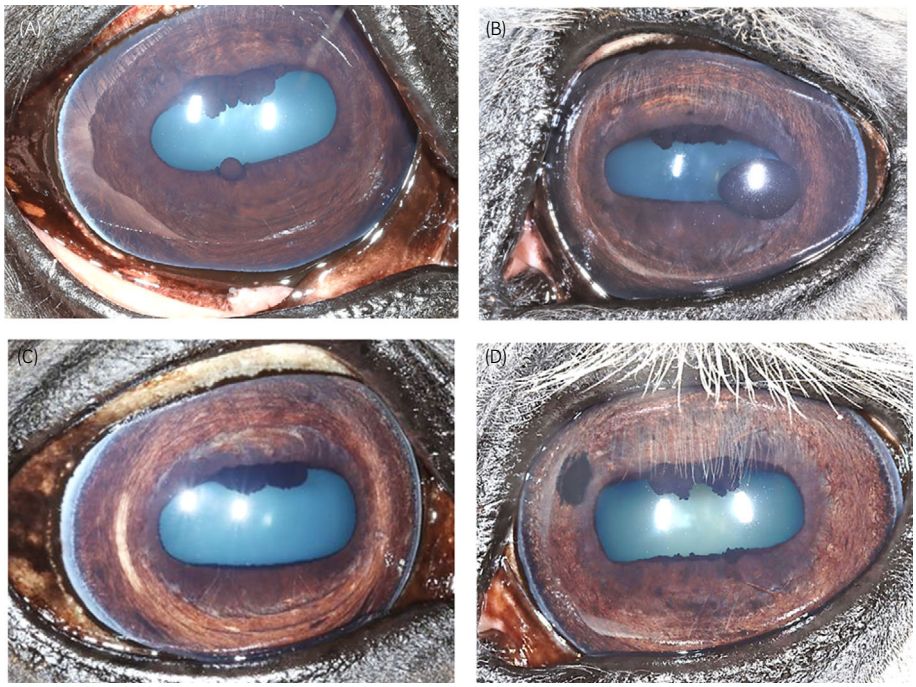

FIGURE 3 Examples of iris abnormalities seen including (A) and (B) cystic granula iridica; (C) focal area of iris hypopigmentation, and (D) focal area of iris hyperpigmentation.

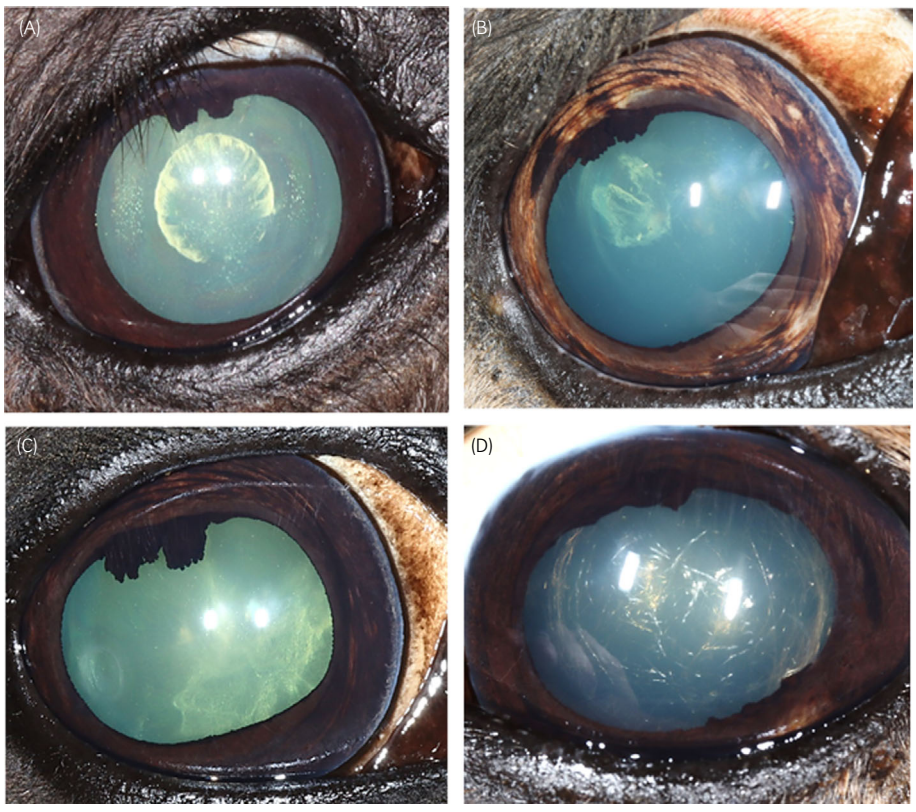

FIGURE 4 Examples of cataracts seen, including (A) perinuclear cataract with nuclear extensions; (B) and (C) posterior cortical cataract, and (D) nuclear pulverulent cataract.

(40.0%). There was a significant association between the presence of posterior segment pathology and age ($p = 0.03$); with animals with posterior segment pathology having a median age of 26.0 years (IQR 24.0, 30.0 years) while those without posterior segment pathology having a median age of 23.5 years (IQR 19.5, 26.5 years). Similarly, animals with senile retinopathy had a median age of 27.0 years (IQR 26.0, 30.0 years) while those without having a median age of 24.0 years (IQR 20.0, 27.0 years) ($p = 0.04$).

A significant association was found between animals being reported to have suspected visual deficits by yard staff working closely with them, and the presence of corneal pathology (Fisher's exact test $p = 0.045$); with 40% of horses with corneal pathology

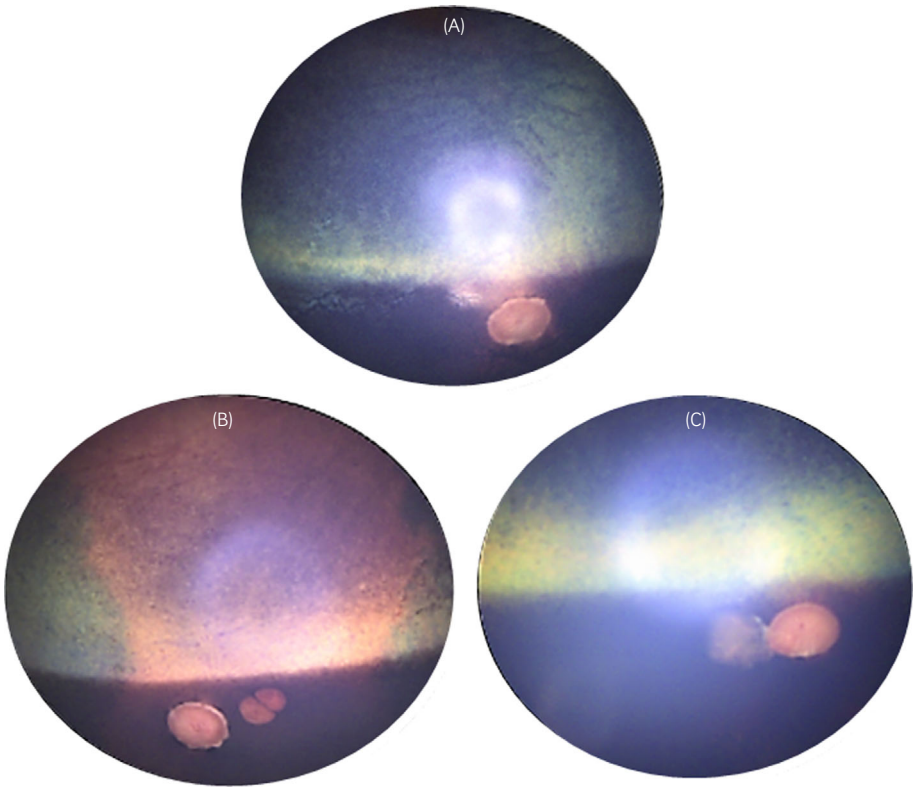

FIGURE 5 Examples of fundic pathology seen, including (A) mild senile retinopathy; (B) retinal pigment epithelium (RPE) coloboma, and (C) peripapillary depigmentation.

being reported to have suspected visual deficits, compared with 4.4% of horses without corneal pathology.

The pathologies investigated did not appear more prone to affect one versus both eyes ($p > 0.05$).

4 | DISCUSSION

This is the first study reporting the prevalence of ocular abnormalities in geriatric equids in the United Kingdom that utilised slit-lamp biomicroscopy and indirect ophthalmology alongside more commonly used diagnostic techniques. A similar, but higher prevalence of ocular disease was found (84.0%) than a previous study of geriatric horses in the United Kingdom performed over 15 years ago (80.1%).[3] The actual disparity between pathology prevalence in these two studies is far greater, as nuclear sclerosis and vitreal degeneration were included as pathological lesions by Chandler et al.,[3] which were highly prevalent (6/83 and 38/83 horses, respectively). Nuclear sclerosis and vitreal degeneration were not considered pathological in the current study as they are normal ageing features of the eye caused by liquefaction of the vitreous and compression of the nuclear lens fibres, respectively.[13]

Similarly, Ireland et al.[4] also included vitreal degeneration and nuclear sclerosis as pathological findings in a survey of geriatric horses in the United Kingdom, which were present in 66.0% and 24.1% of horses, respectively. Reported levels of ocular pathology were therefore higher than the current study at 94.0%. Conversely, corneal pathology was considerably lower (2.6%) compared with the current study (10.0%), which may be due to slit-lamp biomicroscopy providing far greater magnification than the direct ophthalmoscope, allowing the identification of much smaller corneal lesions. The total prevalence of ocular pathology reported in the current study is similar but slightly lower to that reported more recently by Malalana et al. in 2019,[5] who reported a prevalence of 87.7% in horses in Australia; with nuclear sclerosis and vitreal degeneration not being included in analyses of pathological lesions. As slit-lamp biomicroscopy and indirect ophthalmoscopy were not used as part of the examination by Malalana et al.[5] the true prevalence of ocular pathology may well have been higher than that reported. This may be due to Australia having significantly higher solar UV radiation levels than the United Kingdom,[14] which is a risk factor for the development of various ocular pathologies including squamous carcinomas in horses.[15,16] The higher prevalence of adnexal pathology in the Australian study (22.7%, $n = 77$) would support this theory. There is also a well-established link between solar UV radiation and cataract formation in humans and other species (in particular, UVB radiation and cortical cataract).[17–21] Whether cumulative UV radiation is relevant in the equidae lens, which have a far shorter lifespan that humans, is unclear.

In the current study, in addition to a high prevalence of ocular lesions, a wide range of abnormalities were found; the most common specific pathology being cataract, with 52% of animals being found to have a cataract in at least one eye. This is considerably higher than two previous studies,[3,5] probably due to the current study utilising slit lamp biomicroscopy, allowing for the identification of smaller incipient cataracts, and improving visualisation of posteriorly positioned cataracts.

The location of cataracts also differed in this study, with anterior cortical cataracts being the most common, compared with posterior cortical in another UK study.[3] The reasons for this are unknown and the mechanisms behind age-associated cataract development are poorly understood in many species, including horses. Current theories include cumulative effects of multiple risk factors such as long-term UV exposure, diet, systemic disease, uveitis, and trauma.[6,20] Although heredity is a major determinant for the development of cataract in humans and dogs, very little is known about the pathogenesis of equine cataracts, with information often extrapolated from the human and small animal literature. Inherited congenital cataracts have, however, been documented in Thoroughbreds, Quarter Horses, Morgans, and Rocky Mountain horses.[22–24]

Fundic pathology was common, with 42.0% of horses having some form of fundic pathology in one or both eyes. All forms of fundic pathology appeared inactive (i.e., no evidence of associated oedema or exudation, cellular infiltrate, or haemorrhage). Senile retinopathy was the most frequent fundic abnormality encountered and was also found to be associated with older age, which is unsurprising. Senile retinopathy is characterised by varying degrees of linear/branching hyperpigmentation in the peripapillary area and nontapetal fundus.[3] Similar irregular patterns of pigment accumulations can also be seen in cases of equine motor neuron disease (MND); however, the pigmentary disturbances tend to affect both the tapetal and nontapetal fundus, compared with predominantly the nontapetal fundus in senile retinopathy.[25] None of the horses with fundic abnormalities categorised as senile retinopathy had any clinical signs consistent with MND and spent the majority of time at pasture, so MND was considered unlikely. However, assessment of blood vitamin E levels, muscle biopsy, or histopathology of the globe would be required to definitively exclude this.

Focal chorioretinopathy, or bullet-hole chorioretinitis, was present in four horses (8.0%). Bullet-hole chorioretinitis has been suggested to be the result of previous chorioretinitis related to infectious diseases, in particular respiratory disease and EHV-1.[26–28] However, it is also often seen as an incidental finding in many horses.[28,29] The prevalence of bullet-hole chorioretinitis in the present study is considerably lower than that of a previous study of Thoroughbred racehorses in Australia,[30] which reported a 52.5% prevalence. The reason for this disparity is unknown. However, Thoroughbred foals bred on professional stud farms may be more prone to come into contact with EHV-1 through contact with an acutely infected horse, an asymptomatic carrier, or an aborted fetus or placenta.[31,32]

Two horses in the current study with bullet-hole chorioretinitis had additional findings that could be considered consistent with previous chorioretinitis, including a large area of depigmentation in the nontapetal fundus and peripapillary area in one horse, and multiple areas of pallor ventral to the optic nerve head in another. The remaining two horses had no additional ocular pathology. Two horses were found to have areas of peripapillary depigmentation ('butterfly lesion'). Although these have historically been associated with equine recurrent uveitis (ERU),[32,33] blunt trauma and other causes of chorioretinitis may also cause such lesions.[26,34] Neither horse in the current study had additional pathology consistent with ERU or blunt trauma.

One horse (dark bay in coat colour) was found to have a large, temporal, translucent ciliary body cyst, extending into the vitreous cavity. Previous studies have attributed the development of ciliary body cysts in horses to ocular malformation and senile degeneration.[34,35] Plummer et al.[36] reported a relatively high prevalence among a population of miniature horses with a median age of 5.3 years, making a congenital malformation more probable. As with previous reports of ciliary body cysts, the horse in this study had additional fundic lesions in the affected eye, including an area of inactive chorioretinitis immediately posterior to the cyst, which was not present in the contralateral eye.

Corneal lesions were present in 10% of animals; slightly lower than that found by Malalana et al.[5] who reported a 14% prevalence, but higher than a study in the United Kingdom which reported a 3.6% prevalence.[3] The prevalence of corneal lesions was significantly associated with staff-reported visual deficits. Despite quantitative assessment of vision in horses being difficult, it is generally accepted that any change in the clarity of the cornea can affect the refractive ability of the eye. This is supported by the fact that humans with relatively mild corneal opacities often complain of photophobia and blurred vision.[37,38] It would not, therefore be unreasonable to assume the same is the case for equids. Further investigations such as behavioural visual testing would be required to further investigate this association. The prevalence of staff-reported visual deficits was markedly lower than the prevalence of ocular pathology seen on examination. In addition, despite the high prevalence of lesions, diminished vision was not appreciable in any of the animals examined, as assessed by the menace response.

Only four horses (8.0%) had iris abnormalities that could be considered consistent with historic uveitis (e.g., granula iridica atrophy); higher than that found by Chandler et al.[3] who reported 5/85 (5.9%) horses surveyed in a UK population to have signs consistent with previous uveitis.

In the current study, Cobs and Shetlands were found to have the highest proportion of anterior segment pathology, and Thoroughbreds the lowest. To date, there are limited studies investigating ophthalmic abnormalities in the Cob and Shetland breeds. In 2011, Komáromy et al.[39] reported a case series of five PMEL17 (Silver) mutant ponies with Multiple Congenital Ocular Anomalies (MCOA) syndrome, three of which were Shetland ponies. However, none of the Shetlands in the current study had findings consistent with either the cyst or more severe phenotype of MCOA. Further study is therefore required into these breeds to ascertain the significance of these findings.

Despite the associations between age and pathology seen, the lack of a control group of younger animals to help determine which abnormalities were truly due to increasing age, meant that it was not possible to ascertain disease aetiology (e.g., traumatic vs. postinflammatory). However, previous studies of younger horses report a far lower prevalence of ocular pathology. For example, a recent study of draught horses of all ages (median 10 years), reported a 5.5% prevalence of vision-threatening abnormalities, and 33.9% of nonvision-threatening abnormalities.[40] A survey of a closed-herd of 267 Lipizzaners in three separate housing systems in Austria with a mean age of 4, 12 and 8 years, respectively, reported 76.0% of horses to have ocular

abnormalities.[41] However, corneal abnormalities were over-represented (21.7%), with an immune-mediated aetiology being suspected in the majority of these cases. The prevalence of fundic (37.5%) and lenticular (8.9%) pathology was far lower than in the current study.

Limitations of the current study include a relatively small sample size, and a lack of a control group of younger animals to help determine which abnormalities seen were truly due to increasing age. The results of this study also apply to a specific population of equids in the United Kingdom, so wider extrapolation should be made with caution. By examining all animals based at the establishment aged 15 years over, we hope to have reduced possible bias introduced from only examining animals with suspected ocular disease.

In conclusion, this study suggests that geriatric equids in the United Kingdom have a higher prevalence of true ocular pathology than previously reported. However, the pathologies observed in this study did not appear to be interfering with the quality of life of the animals examined. The association between the presence of corneal lesions and staff-reported visual deficits is an interesting finding and warrants further investigations. Regular ophthalmic examination of the older equid, ideally utilising the techniques described in this study, is advised to assess for any lesions that may affect vision and therefore welfare, and performance.

AUTHOR CONTRIBUTIONS

Ria Chalder and Benjamin Blacklock contributed to study design, data collection, data interpretation and manuscript preparation. Claudia Hartley contributed to data collection and manuscript preparation. Nicola Housby-Skeggs and Claire Clark assisted with data collection. Danica Pollard performed data analysis. All authors approved the final version of the manuscript. Ria Chalder had full access to all the study data and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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FUNDING INFORMATION

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CONFLICT OF INTEREST STATEMENT

No competing interests have been declared.

PEER REVIEW

The peer review history for this article is available at https://www.webofscience.com/api/gateway/wos/peer-review/10.1111/evj.13941.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ETHICAL ANIMAL RESEARCH

Ethical approval was granted by the Royal (Dick) School of Veterinary Studies Veterinary Ethical Review Committee (reference 120.21).

INFORMED CONSENT

All horses were owned by the Horse Trust charity, and written consent was obtained prior to examination.

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