Ocular disease is a frequent finding in working horses. This study aimed to estimate the prevalence and types of ocular pathology, and explore risk factors potentially associated with disease within a population of working horses in Ethiopia. In total, 1049 horses were selected from horses attending clinics run by the Society for Protection of Animals Abroad (SPANA). Each had an ophthalmic examination conducted under field conditions using a pen-torch. All owners completed a short questionnaire. The prevalence of ocular abnormalities was 23.5 per cent (95 per cent confidence interval (CI) 18.0 per cent to 30.1 per cent) and the percentage of horses with an abnormality in at least one eye was 43 per cent (95 per cent CI 28.7 per cent to 58.4 per cent), although this varied between towns. Mild eye pathology and end-stage disease with irreversible pathology were most common. There were significantly more eye abnormalities in the right eye compared with the left, and older horses were more likely to have ocular pathology. Only 55.1 per cent of owners had noticed there was an ocular abnormality present, and only 2.2 per cent had received any previous treatment for eye disease. Only 1.9 per cent presented to the clinic because of an eye problem. There appears to be either a lack of owner awareness, or a low perception of the importance of eye disease among owners.

**Introduction**

An estimated 60 per cent of the world’s horse population, and over 95 per cent of all donkeys and mules are found in developing countries (Pritchard and others 2005). Ethiopia possesses approximately half of Africa’s equine population; according to UN Food and Agriculture Organisation there are over 7 million donkeys, mules and horses in Ethiopia, including 1.9 million horses (Anon 2010). Previous studies have demonstrated the value of working equine to communities in developing countries (Pearson and Vall 1998). In urban towns in Ethiopia, horse-drawn taxi carts are a source of sustainable income for a significant number of Ethiopian families (Dinka and others 2006), and provide the only affordable transportation service in many towns (Ameni 2006).

Despite the scarcity of literature, it appears ocular disease is a frequent problem in working equine in developing countries. An assessment of the welfare of 4889 working equine carried out by Pritchard and others (2005), in several countries, estimated that 66.4 per cent of horses had an ocular abnormality, and this was higher in donkeys (86.4 per cent). The eye abnormalities included mild discharge, ocular pain, keratitis, uveitis and blindness. The authors suggested that further research to identify risk factors for eye abnormalities was warranted.

There are few published studies investigating ocular disease in Ethiopian horses. Wounds and ocular injuries were the most frequently recorded health concerns in Gonder (Anon 2001), and ocular injuries due to ill-fitting blinkers and tack were reportedly common (Bradbury 2002). A survey of 250 carthorses found 21 per cent had an ophthalmic condition, with >60 per cent of these involving the right eye (Anon 2005), and ocular infections were observed in 5.4 per cent of 241 randomly selected carthorses examined in the middle Rift Valley region of Ethiopia (Shelima and others 2006).

Ocular disease represented 5 per cent of cases presenting for non-routine problems to the veterinary clinics of Society for Protection of Animals Abroad (SPANA) (unpublished data). A similar percentage (5.4 per cent) of donkeys presented with ocular disease to Donkey Sanctuary clinics (Getachew and others 2002), with the most common pathologies being medial canthal wounds due to habronemiasis and fly strike, conjunctivitis and corneal ulcers, scars and opacities generally attributed to trauma.

The aims of this study were to determine the prevalence, grade the severity and record the pathology of ocular abnormalities in a population of working horses in Ethiopia, and to generate hypotheses regarding the potential risk factors for these abnormalities.

**Materials and methods**

**Study design**

A cross-sectional study in horses attending SPANA mobile clinics in seven towns in the Oromia and Amhara regions of Ethiopia was conducted. Since a pilot study involving 118 horses conducted in five towns in 2006 estimated the overall prevalence of eye disease to be 19 per cent, varying from 12 per cent to 32 per cent among the different towns (SPANA, unpublished data), the average difference between the overall and the individual town prevalence was 5.9 per cent. This
provided a between-cluster variance of 0.0035. A cluster sample size calculation (Thrusfield 1995) using this estimate, and an expected prevalence of 19 per cent with a desired absolute precision of 5 per cent, indicated that a sample size of 146 horses per town would be required.

Horses selected for the study were ‘the next 150 horses’ presented at one of the SPANA mobile clinics in each town, subject to other time commitments and emergencies requiring the examining veterinary surgeon. Sampling took place on separate clinic days over the course of one year between February 2008 and February 2009.

A short, one-page questionnaire and recording sheet (available on request) were designed. This collected data on signalment, history, reason for presentation and history of eye disease (if known) such as duration, problem with vision or pain, any specific incidents which may have caused eye disease, and whether previous treatment had been sought.

A bilateral ophthalmic examination was performed by one veterinary surgeon (NA) using pen-torch illumination in field conditions. Menace reflex and pupillary light responses were assessed, and the presence of ocular discharge, phonophobia and blepharospasm recorded. Where appropriate, fluorescein stain and topical anaesthetics were applied. Where necessary, appropriate treatment was given free of charge. A grading system (Table 1) refined after the pilot study, was developed to ensure consistent categorisation. Additionally, a laminated booklet depicting images of typical eye pathology grouped using the grading scheme provided examples (available on request). A list of diagnostic codes was provided as examples of expected common presentations. These included conjunctivitis, inflammatory eye, corneal ulceration, end-stage blind eye, habronemiasis, tumour, foreign body, traumatic wound and examples of each were illustrated within the laminated booklet. Where a diagnosis could be reached this was recorded on the questionnaire.

Statistical methods
The overall prevalence of abnormalities (including both eyes) was calculated using within-horse clustering and within town by use of an intercept-only 3-level, multilevel model (MLwiN Version 2.1 Centre for Multilevel Modelling, University of Bristol). The prevalence at horse level (percentage of horses with at least one eye abnormality) was calculated adjusting for clustering within towns using an intercept only 2-level, multilevel model. Confidence intervals (CIs) were calculated using the standard errors from the intercept-only models.

Descriptive statistics, including medians for continuous data and proportions for categorical data were produced. Kruskal-Wallis tests were used to test the statistical significance of associations between categorical and continuous variables, and chi-squared tests were used to test associations between categorical variables. A 2-level, multilevel model allowing for clustering within horse was used to assess a limited number of variables and their association with an outcome of any eye pathology. These were town, age, duration of ownership, and whether the lesion was in the left or right eye. Final estimates of variables retained in the model were obtained using penalised quasi-likelihood with second-order Taylor series expansion (Rasbash and others 2009). Two-way interaction terms were tested between all plausible biological terms. The critical probability for all analyses was set at 0.05.

Results
At the seven clinic sites, a total of 1049 horses had an ophthalmic examination (Table 2). The majority (96.3 per cent) were used as cart-horses and were male (99 per cent) ( geldings accounted for 59.7 per cent). The median age was 15 years based on dental estimation. The age of the horses was significantly (P<0.001) younger at the Debra Brehan site (median 10) compared with other sites (medians 14–15). The median duration of ownership was six months (IQ range 2, 24, range 0–216 months), and horses had been owned for significantly (P<0.001) longer in Debra Brehan (median 22 months) compared with other sites (median 4–6 months). The primary reasons for presenting at the clinic were for vaccination (43 per cent) and deworming (51 per cent), followed by respiratory problems (6 per cent). Only 1.9 per cent of horses were presented specifically for an eye problem.

After adjusting for clustering, the overall prevalence of eye abnormalities was 23.3 per cent (95 per cent CI 18.0 per cent to 30.1 per cent) and the prevalence of horses with a problem in at least one eye was 43 per cent (95 per cent CI 38.7 per cent to 48.4 per cent). However, the within-town prevalence varied from 16.8 per cent to 39.3 per cent, and there also appeared to be a difference between left and right eye prevalence (Table 2).

 Mild eye pathology affecting only one structure, and end-stage disease with irreversible pathology, were the most common grades (Table 3), and grade 3 was rarely seen. Among eyes with pathology, the most common diagnoses were scar and end-stage blind eye (Table 4). There were also a number of horses with corneal ulceration.

Just over half the eyes with pathologic changes had a problem with vision (54.2 per cent), and ocular discharge was present in 49.9 per cent of cases. Just under a third had evidence of ocular pain (30.5 per cent). Both Nazareth and Modjo towns had significantly higher proportions of eyes that had ocular discharge (P<0.01) and pain (P<0.001).

### TABLE 1: Grading system developed to grade ocular pathology in a study of ocular disease in working equines in Ethiopia

| Grade | Category description | Descriptive examples of ocular pathology relating to each category |
|-------|----------------------|---------------------------------------------------------------|
| Grade 0 | Normal eye | Mild primary conjunctivitis |
| Grade 1 | Mild eye pathology affecting only one structure | Non-ulcerative keratopathy for example, corneal dystrophy, scarring, epithelialisation, opacity |
| Grade 2 | Ulceration of the cornea without pathology of other structures (may or may not be painful) | Entropion without complication |
| Grade 3 | Severe eye pathology involving multiple structures of the eye, or if there is severe pain present | Severe deep ulcers extending to Descemet’s membrane |
| Grade 4 | End-stage eye (no eye left). Irreversible pathology | Phtitic, blind shrunken eyes |

In the laminated booklet. Where a diagnosis could be reached this was recorded on the questionnaire.
also more likely to have ocular pathology. Those owned for a longer time by the current owner were significantly more eye abnormalities in the right eye compared with the left eye, and that older horses were more likely to have eye lesions. Horses bought with an eye problem were associated with the presence of a grade 4 abnormality (P<0.001). Estimates allow for clustering of eyes within animal (variance 0.47, se 0.14) (second-order penalised quasi-likelihood).

**Discussion**

This study provides further evidence of the high frequency of ocular pathology in working equine, many of the cases encountered in this study had end-stage, irreversible pathology. This represents a significant welfare problem in working horses in Ethiopia.

There have been few studies into the prevalence of ocular disease in horses with which to compare these results. The prevalence of vision-threatening eye disorders in horses in developing countries has been reported as 5 per cent to 10 per cent (Hurn and Turner 2006). This correlates with an American-based study reporting 7.4 per cent of horses >6 months old had ocular disease, with the potential to threaten vision (Gilger 2005). However, comparison with western equine populations may be misleading given the differing nature of the use of the animals, and environmental and husbandry conditions within which equines may be kept in developing countries. The prevalence of eye abnormalities in this study is lower than that reported by Pritchard and others (2006), however, it is higher than many of the previous studies conducted on carthorses in Ethiopia (Ayele and others 2002, Shelima and others 2006). Previous studies reported that ocular disease was the reason for presentation to clinics for only approximately 5 per cent of animals (Getachew and others 2002, ANCON 2005). It may be that this is due to owners failing to seek treatment for ophthalmic disease or injury and, hence, do not present their horses at clinics. Alternatively, it may reflect recording procedures for cases presenting to clinic, or may be influenced by season. Our sampling strategy aimed to ensure a representative sample of horses attending clinics from each town. However, this was limited to the clinic accessing population and, therefore, may result in the reported prevalence being an underestimate of ocular disease within areas where free treatment is unavailable.

The ocular examination in this study was limited by the lack of an ophthalmoscope or hand lens, and an inability to examine horses

**Table 2: Prevalence of ocular abnormalities at different towns and in left, right and both eyes in 2098 eyes in 1049 horses examined in seven towns in the Amhara and Oromia regions of Ethiopia**

| Site (total horses=1049) | Ocular abnormality n (% 2098 total eyes) | 95% CI for ocular abnormality | Horses with at least one ocular abnormality n (% 1049 horses) | Ocular abnormality right eye n (%) | Ocular abnormality left eye n (%) | Bilateral ocular abnormality n (%) |
|--------------------------|----------------------------------------|------------------------------|-------------------------------------------------------------|----------------------------------|-------------------------------|----------------------------------|
| Akaki (150)              | 89 (29.7)                              | 24.4 to 34.8                | 71 (47.3)                                                  | 27 (38.0)                        | 26 (36.6)                     | 18 (25.4)                        |
| Debre Brehan (150)       | 50 (16.7)                              | 12.4 to 20.9                | 43 (28.7)                                                  | 26 (60.5)                        | 10 (23.3)                     | 7 (16.3)                         |
| Debre Zeit (149)         | 56 (18.8)                              | 14.4 to 23.2                | 48 (32.2)                                                  | 21 (43.8)                        | 19 (39.6)                     | 8 (16.7)                         |
| Hawassa (150)            | 69 (23.0)                              | 18.2 to 27.8                | 57 (38.0)                                                  | 23 (40.4)                        | 22 (38.6)                     | 12 (21.1)                        |
| Modjo (150)              | 118 (39.3)                             | 33.8 to 44.9                | 95 (63.3)                                                  | 43 (45.3)                        | 29 (30.5)                     | 23 (24.2)                        |
| Nazareth (150)           | 108 (36.0)                             | 30.6 to 41.4                | 82 (54.7)                                                  | 34 (41.5)                        | 22 (26.8)                     | 26 (31.7)                        |
| Shashemene (150)         | 71 (23.7)                              | 18.9 to 28.5                | 58 (38.7)                                                  | 30 (51.7)                        | 15 (25.9)                     | 13 (22.4)                        |
| Overall                  | 561 (23.5)                             | 18.0 to 30.1                | 454 (43)                                                   | 204 (44.9)                       | 143 (31.5)                    | 107 (23.6)                       |

*Estimates adjusted for clustering CI, confidence interval

**Table 3: Grades of ocular disease in each of the seven towns for 561 eyes in 454 horses**

| Grade | Town (N) | Grade 1 N (%) | Grade 2 N (%) | Grade 3 N (%) | Grade 4 N (%) |
|-------|----------|---------------|---------------|---------------|---------------|
|       |          | N (%)         | N (%)         | N (%)         | N (%)         |
|       |          | Akaki (300)   | Debre Brehan (300) | Debre Zeit (298) | Hawassa (300) | Modjo (300) | Nazareth (300) | Shashemene (300) |
|       |          | 40 (13.3)     | 24 (8)        | 20 (6.7)      | 36 (12.0)     | 53 (17.7) | 43 (14.3)     | 26 (8.7)          |
|       |          | 8 (2.7)       | 8 (2.7)       | 11 (3.7)      | 12 (4.0)      | 15 (5.0) | 20 (6.7)      | 16 (5.3)          |
|       | 10 (3.3) | 1 (0.3)       | 2 (0.7)       | 7 (2.3)       | 6 (2.0)       | 11 (3.7) | 4 (1.3)       | 4 (1.3)           |
|       | 31 (10.3)| 17 (5.7)      | 23 (7.7)      | 14 (4.7)      | 44 (14.7)     | 34 (11.3) | 25 (8.3)      | 188              |
|       | 242      | 90            | 41            | 188           |              |            |              |                  |

Percentages are of the total number of eyes examined in that town

**Table 4: Presumptive diagnoses of ophthalmic pathology (n=504) in 1049 horses in seven towns in Ethiopia**

| Diagnosis                  | % (out of total 504 eyes that were given a diagnosis) |
|----------------------------|-----------------------------------------------------|
| Conjunctivitis (including inflammatory eye, habronemiasis) | 44 (8.7) |
| Corneal ulceration         | 87 (17.3) |
| End-stage blind eye        | 163 (32.3) |
| Tumour                     | 1 (0.2)   |
| Foreign body present       | 1 (0.2)   |
| Traumatic wound            | 37 (7.3)  |
| Corneal scar               | 168 (33.3) |
| Other                      | 3 (0.6)   |

NB: 57 eyes with pathology were not given a diagnosis code and are therefore missing values

**Table 5: Multilevel, multivariable logistic regression model of factors associated with presence or absence of ocular pathology in 2098 eyes in 1049 horses in seven towns in Ethiopia. Estimates allow for clustering of eyes within animal (variance 0.47, se 0.14) (second-order penalised quasi-likelihood)**

| Variable   | Category     | Odds of ocular pathology | (95% CI odds ratio) | P value |
|------------|--------------|--------------------------|---------------------|---------|
| Eye        | Left         | Ref                      | 1.00                | 0.001   |
|            | Right        | 1.41                     | 1.1 to 1.7          |         |
| Age (years)|              |                          |                     | 0.001   |
|            |              | 1.12                     | 1.1 to 1.2          |         |
| How long owned (months) | 1.01     | 1.0 to 1.01             | 0.001               |         |
| Town       | Debre Brehan | Ref                      | 1.00                | 0.001   |
|            | Akaki        | 1.89                     | 1.2 to 3.0          | 0.006   |
|            | Debre Zeit   | 1.03                     | 0.6 to 1.7          | 0.9     |
|            | Hawassa      | 1.03                     | 0.6 to 1.7          | 0.9     |
|            | Modjo        | 2.98                     | 1.9 to 4.7          | <0.001  |
|            | Nazareth     | 2.53                     | 1.6 to 4.0          | <0.001  |
|            | Shashemene   | 1.04                     | 0.6 to 1.7          | 0.9     |

CI confidence interval, Ref Reference category
In a dark environment, since clinics were conducted outdoors. Consequently, detailed description of lens, fundic and retinal pathology was not possible, and this could mean that the reported prevalence is underestimated. However, the grading categories were such that broad categorisation was possible in field conditions using the equipment available. The use of a pen-torch is in keeping with tools available to other veterinarians and animal health workers in similar resource-poor settings.

All examinations were carried out by one veterinary surgeon (NA), and hence, problems with interobserver disagreement, as demonstrated by Burn and others (2009), were eliminated. In addition, detailed descriptions and a laminated booklet with images of typical eye pathology grouped using the grading scheme were provided (available upon request), which has also been suggested to improve identification of eye abnormalities, including subtle lesions (Burn and others 2009). However, there is a possibility of individual bias when one observer conducts all examinations, and whether this grading system would give good interobserver and intraobserver reliability is unknown and requires further testing.

Few horses in this study presented to the clinic because of ocular abnormality, and few had received any previous treatment in spite of the availability of free treatment for carthorse owners/drivers accessing SPANA mobile veterinary clinics. This could be for several reasons. Owners may not recognise an abnormal eye, or the signs of ocular pain. Further, owners may recognise an abnormality but may be unaware of the importance of early treatment to prevent ongoing eye pathology and potential loss of the eye. Other influential factors upon whether treatment is sought could include the prioritisation of eye disease compared with other common diseases set within a context of practical, financial and social resources and pressures.

The results from this study suggest this is an area where an educational initiative to encourage owners to monitor eye health and recognise abnormalities early during the disease process, may be beneficial, as almost 50 per cent of owners were unaware that the horse had ocular pathology. Potential reasons for not seeking veterinary treatment include financial constraints and absence of adequate veterinary services (Shelima and others 2006). Although SPANA provides free treatment at the towns in this study, a third of owners purchased their horse with existing eye pathology (this may be an underestimate if ocular pathology is not always recognised by owners), and treatment may not have been available in the town of origin. Increased availability of veterinary services for working horses and donkeys may therefore be beneficial.

Few owners in this study knew the origins of ocular disease in their animal and this warrants further investigation. This may be due to the disproportionate early duration of ownership, and that many of these owners purchased the horses with an existing ocular lesion. All specific incidents reported by the owners were traumatic and this may give an indication of the possible historic cause of a proportion of grade 4 eyes, however, this observation should be assessed with caution due to the possibility of recall bias or potential misattribution of cause. Seventeen per cent of the abnormal eyes in this study had corneal ulceration which could have arisen from infectious agents or surface trauma. The latter could include injuries caused by ill-fitting or poorly repaired harness and blinkers, foreign bodies or injuries arising from a whip.

Only a small number of horses were found to have acutely painful grade 3 lesions demonstrating current severe eye pathology, and this appears disproportionate given the large number of grades 1 and 4 reported. This could be due to owners seeking treatment elsewhere, for example, traditional healers (personal communication), or due to the cross-sectional nature of the study where chronic diseases are more likely to be included (Dohoo and others 2009). Alternatively, the initiating cause of eye disease may be occurring elsewhere before horses are brought into these towns.

A number of risk factors for ocular disease were found, including increased age of the horse, longer duration of ownership, the right eye versus left eye and town within which the animal resided. The prevalence of eye disease was significantly higher in the right eye compared with the left, and the reasons for this are not clear. Since a whip injury was identified as the specific reason by six owners, a possible explanation includes whipping by predominantly right-handed drivers. Foreign bodies, such as stones flicking up from the road when traffic passes the cart are another possible cause for this asymmetrical distribution.

Trauma is a relatively common cause of eye disease in the horse (Gilger 2005), and the cornea is the most common location for eye injuries (Cutler 2004), possibly due to its large surface area and prominent vulnerable position. Getachew and others (2002) reported that trauma was a common cause of ocular pathology in donkeys in Ethiopia and of 805 working carthorses with ocular abnormalities admitted to a hospital in Brazil, 36 per cent of these lesions were caused by trauma (Reichmann and others 2008). Severe trauma and inflammation within the eye has the potential to result in phthisis bulbii (Bedford 1985). Given that the two most common diagnoses within this population were corneal scars followed by end-stage blind eye, it may be that trauma contributes to the aetiology. Often head-collars have adomments placed near the eye or may be poorly maintained which could contribute to the risk of ocular trauma (personal communication), and this may be an additional area to address within an ocular health education initiative. However, infectious disorders of the eye, such as fungal or bacterial keratitis, may also lead to the same end result if not managed correctly (Brooks 2004).

The findings that increased age and increased duration of ownership were associated with increased risk of ocular abnormalities may be due to increased exposure to risk factors over the working lifetime of the horse. Alternatively, it may be due to a reduced ability to sell animals with abnormal eyes and, therefore, increased retention of horses with ocular abnormalities. One concern is that end-stage eyes may devalue the horse, therefore lowering purchase price. A lower price may make a purchase seem more attractive to a less affluent purchaser, and this aspect has socioeconomic as well as welfare implications (personal communication). These are factors that warrant further investigation in order to understand owners’ priorities and perceptions of eye disease within the socioeconomic context of working equid health and disease. It may be that owners have differing perceptions of the importance of ocular disease among older horses akin to a study of geriatric horses in the UK, where some health conditions were perceived to be part of the ageing process and, therefore, more acceptable to some owners (Ireland and others 2012).

The difference in prevalence between towns is an interesting finding, and the reasons for this were not explained by other variables, such as age of the horse. The trade route (purchase and sales) of horses in this area of Ethiopia is predominantly unknown. However, it appears that horses change hands regularly, and the majority (90 per cent) were purchased further investigation in order to understand owners’ priorities and perceptions of eye disease within the socioeconomic context of working equid health and disease. It may be that owners have differing perceptions of the importance of ocular disease among older horses akin to a study of geriatric horses in the UK, where some health conditions were perceived to be part of the ageing process and, therefore, more acceptable to some owners (Ireland and others 2012).

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References

ABEBE, R. & WOLDE, A. (2010a) Preliminary survey on equine trypanosomosis and its vectors in Asosa and Homosha districts in Benishangul Gumuz Regional State, northwest Ethiopia. Livestock Research for Rural Development 22(1)

ABEBE, R. & WOLDE, A. (2010b) A cross-sectional study of trypanosomosis and its vectors in donkeys and mules in Northwest Ethiopia. Parasitology Research 106, 911–916

AMENI, G. (2006) Epidemiology of equine histoplasmosis (epizootic lymphangitis) in carthorses in Ethiopia. The Veterinary Journal 172, 160–165

ANON (2005) Field Report on The Gharry Horses of Gonder. In: SPANA Unpublished Report

ANON (2005) Welfare of carthorses Baseline Survey (Ethiopia). In: SPANA Unpublished Report

ANON (2010) FAOSTAT® FAO Statistics Division. http://faostat.fao.org/. Accessed February 29, 2012

AYELE, G., FESEHA, G., BOJIA, E., GETACHEW, M., ALEYEHU, F., TESFAYE, M., AMARE, B., DEREJE, N., CHALA, C., ASEFA, A., ANZUINO, G. & TRAWFORD, A. (2006). Principle health problems of donkeys in Daga Bora district of Ethiopia. Proceedings 5th International Colloquium on Working Equines. Eds A. Pearson, C. Muir & M. Farrow. Addis Ababa, Ethiopia, October 30 to November 2, 2006. pp 162–168

BEDFORD, P. (1985) Ocular disease in the horse. In Practice 7, 153–157

BRADbury, H. (2002) Case study: the gharry horses of Gonder, Ethiopia- workable solutions for working horses. Proceedings of the 4th International Colloquium on Working Equines. Eds A. Pearson, D. Fielding & D. Tabbaa. Hama, Syria, April 20 to 26, 2002. pp 232–236

BROCKS, D. E. (2004) Inflammatory stromal keratopathies: medical management of stromal keratomalacia, stromal abscesses, eosinophilic keratitis, and band keratopathy in the horse. Veterinary Clinics of North America: Equine Practice 20, 345–360

BURN, C. C., PRITCHARD, J. C. & WHAY, H. R. (2009) Observer reliability for working equine welfare assessment: problems with high prevalence’s of certain results. Animal Welfare 18, 177–187

CUTLER, T. (2004) Corneal epithelial disease. Veterinary Clinics of North America, Equine Practice 20, 319–345

DINKA, H., SHELIMA, B., ABELTI, A., CELETA, T., MUME, T. & CHALA, R. (2006) Socio-economic importance and management of carthorses in the mid rift valley of Ethiopia. Proceedings 5th International Colloquium on Working Equines. Eds A. Pearson, C. Muir & M. Farrow. Addis Ababa, Ethiopia, October 30 to November 2, 2005. pp 181–188

DOHO, J., MARTIN, W. & STRYHN, H. (2009) Introduction to observational studies. In: Veterinary Epidemiologic Research. 2nd edn. Prince Edward Island, Canada: VER Inc. pp 151–166

GETACHEW, M., FESEHA, G., TRAWFORD, A. F., BOJIA, E., ALEYEHU, F. & AMARE, B. (2006) Some common clinical cases and interventions at the donkey health and welfare project – donkey sanctuary, Debre Zeit, Ethiopia. Proceedings of the 4th International Colloquium on Working Equines, Eds A. Pearson, D. Fielding & D. Tabbaa. Hama, Syria, April 20 to 26, 2002. pp 96–109

GILGER, B. C. (2005) Equine Ophthalmology. 1edn. St Louis: Elsevier Saunders.

HURN, S. D. & TURNER, A. G. (2006) Ophthalmic examination findings of thoroughbred racehorses in Australia. Veterinary Ophthalmology 9, 95–100.

KNOTTENBELT, D. C. & PASCOE, R. R. (1994) In: Colour atlas of diseases and disorders of the horse. 1st edn. London: Published by Mosby

IRELAND, J. L., CLEGCG, P. D., MCCOWAN, C. M., MCKANE, S. A., CHANDLER, R. J. & PINCHBECK, G. C. (2012) Comparison of owner-reported health problems with veterinary assessment of geriatric horses in the United Kingdom. Equine Veterinary Journal 44, 94–100

PRITCHARD, J. C., LINDBERG, A. C., MAIN, D. C. J. & WHAY, H. R. (2005) Assessment of the welfare of working horses, mules and donkeys, using health and behaviour parameters. Preventive Veterinary Medicine 69, 265–283

RASBASH, J., STEELE, F., BROWN, W. J. & GOLSTEIN, H. (2009) Logistic models for binary and binomial responses. In: A User’s Guide to MLwiN Version 2.10. Centre for Multilevel Modelling, University of Bristol. pp 128–129

REICHMANN, P., DEARCO, A. C. D. D. & RODRIGUES, T. C. (2008) Occurrence of ophthalmologic diseases in horses used for urban cart hauling in Londrina, PR, Brazil. Ciencia Rural 38, 2525–2528

SHELIMA, B., DINKA, H., ABELTI, A., MUME, T., CELETA, T. & CHALA, R., 2006. Major constraints and health management of carthorses in the mid rift valley of Ethiopia. Proceedings 5th International Colloquium on Working Equines. Eds A. Pearson, C. Muir & M. Farrow. Addis Ababa, Ethiopia, October 30 to November 2, 2006. pp 231–241

THROSFIELD, M. (1995) Surveys. In: Veterinary Epidemiology. 2nd edn. London, UK: Blackwell Science Ltd. pp 164–167

VASEY, J. R. (1981) Equine cutaneous habronemiasis. Compendium on Continuing Education for the Practising Veterinarian 8, 290–298