



Bushell, R., and Murray, J. (2016) A survey of senior equine management: owner practices and confidence. *Livestock Science*, 186, pp. 69-77.

There may be differences between this version and the published version. You are advised to consult the publisher's version if you wish to cite from it.

<http://eprints.gla.ac.uk/115049/>

Deposited on: 29 August 2016

Enlighten – Research publications by members of the University of Glasgow  
<http://eprints.gla.ac.uk>

1 **A SURVEY OF SENIOR EQUINE MANAGEMENT: OWNER PRACTICES**  
2 **AND CONFIDENCE**

3 R.Bushell<sup>1a</sup> and J.Murray<sup>2</sup>

4 *<sup>1</sup>School of Biological Sciences, University of Edinburgh, The King's Buildings*  
5 *EH9 3BF, UK*

6 *<sup>2</sup>Faculty of Veterinary Medicine, University of Glasgow Veterinary School,*  
7 *Bearsden Road, Glasgow, G61 1QH, UK*

8 *<sup>a</sup>Madam's Hill, Easthope, Nr Much Wenlock, Shropshire, TF13 6DJ, UK*

9 Corresponding author: Rebecca Bushell. [bushellr@live.com](mailto:bushellr@live.com) 01746785269

10 **Abstract**

11 Senior equines (16 years and over) comprise a significant proportion of the  
12 global equine population and there is concern that their management  
13 practices may not be entirely appropriate, particularly given recent evidence to  
14 suggest an under recognition of disease for which alterations are necessary to  
15 ensure optimal care. However, there has been minimal research to investigate  
16 the appropriateness of senior equine care and how capable their carers' are in  
17 providing care. Consequently, this study used a survey approach to  
18 investigate the management practices and health care provision for senior  
19 equines. A series of likert type questions were used to assess respondent  
20 confidence in aspects of management regimes, recognition of age associated  
21 equine conditions, and perceived importance of nutrition advice sources,  
22 using a scale of 1-5 (1 being low and 5 high confidence). In addition, a  
23 combination of multiple response and open questions were used to report

24 management practices in place. The survey was administered to those  
25 enrolled on a massive open online equine nutrition course and received 1342  
26 responses. Results indicated an encouraging provision of care for senior  
27 equines, with associated high carer confidence in management regimes and  
28 concerted effort to understand and fulfil their senior equines requirements.  
29 However, the study highlighted key areas of requirements for owner  
30 education. In particular, the combined lack of frequent body condition  
31 monitoring and low confidence in disease recognition and supplement  
32 feeding. There was also a prevalence of suboptimal strategic worming and dry  
33 hay feeding. Given that veterinarians were consistently considered as the  
34 most important advice source it is likely that they will have an important role to  
35 play in the education that is required.

36

37 **Key words (5):** Equine, senior, nutrition, management, survey.

38

### 39 **Introduction**

40 Aging equines represent an increasing proportion of the global equine  
41 population (Ireland *et al.*, 2011), but they can often be overlooked.  
42 Inappropriate management regimes can facilitate or exacerbate diseases and  
43 conditions at any time of life (Secombe and Lester, 2012). But, whilst age is  
44 not necessarily indicative of degeneration, senescence increasingly  
45 predisposes equines to particular conditions, the majority of which are related,  
46 to nutrition (Jarvis, 2009). Loss of body weight and or condition is prevalent  
47 (Jarvis, 2009) and could be influenced by a variety of age-associated factors  
48 including endocrine disorders, digestive dysfunction from dentition to nutrient

49 | absorption, in-appetence, and musculoskeletal conditions (Elzinga *et al*, 2011;  
50 | Durham *et al*, 2014). In addition obesity is also a major concern and  
51 | exacerbates age associated disease (Alford *et al*, 2001) and requires different  
52 | management (Geor and Harris, 2009; Secombe and Lester, 2012). It is  
53 | essential therefore that owners have sufficient knowledge to formulate  
54 | management and nutritional regimes, and also that they monitor their senior  
55 | equines condition to assess if or indeed when alterations are required (Geor  
56 | and Harris, 2009; Durham *et al.*, 2014) thus optimising senior equine care. For  
57 | owners to do this requires that they have the necessary information but there  
58 | is a paucity of health, disease, and nutritional information for the senior equine  
59 | (Ireland *et al*, 2011) and a variety of sources, which may undermine their  
60 | confidence. There have been few attempts to assess the feeding and  
61 | management practices of senior equines, particularly with a view to the  
62 | confidence owners have in both recognizing prevalent conditions and  
63 | formulating their management regimes as a consequence. The objectives of  
64 | the present study were firstly, to assess in general the feeding and  
65 | management practices of senior equines for their appropriateness. Secondly,  
66 | to assess owner confidence in recognizing conditions associated with the  
67 | senior equine and formulating management regimes in relation to their  
68 | experience. Finally, to ascertain which sources of information are most  
69 | important for them in so doing.

70

## 71 **Materials and methods**

### 72 *Study population*

73 The study population included those enrolled on a massive open online  
74 course in equine nutrition, which ran from February to March 2014. The  
75 course was provided by Coursera, which is an online platform offering free  
76 open courses in a variety of disciplines through affiliated academic  
77 institutions. Participation can have multiple motivations from furthering  
78 knowledge to enhancing career prospects as statements of accomplishment  
79 and verified certificates are available. Those enrolled on this course  
80 represented various nationalities and equine backgrounds. Thus, this offered  
81 an ideal opportunity to reach a large population of horses owners or carers.

82

### 83 *Questionnaire Design*

84

85 An online survey was created in Survey Monkey, a free online software for  
86 survey development and administration. specifically for the purposes of the  
87 survey to gather information on the feeding and management practices of  
88 senior equines, to assess owner confidence in these practices and disease  
89 recognition, and investigate sources of nutritional advice. Participants were  
90 asked to complete the survey at the start of the course. The senior equine  
91 was defined as 16 years and older to encompass all ages considered in  
92 previous literature (McGowan, 2010a; Ireland *et al.*, 2011). The survey  
93 comprised three sections: (1) demographics of owner and equines; (2) current  
94 feeding practices and management of senior equines; (3) owner confidence  
95 and advice sources. The majority of questions were either multiple choice,  
96 some allowing multiple responses, or likert scale rating questions where there  
97 was a choice of a number of fixed alternatives Open text boxes allowed for

98 'other' comments. Only participants with senior equine management  
99 experience answered questions pertaining to senior equine management.  
100 Every effort was made to link the questions to the research objectives and to  
101 control for confounding factors. A pilot study was conducted to identify  
102 technical issues with administration and clarity of questions and instructions.

### 103 *Statistical treatment of results*

104

105 Data were gathered in Survey Monkey and downloaded into excel where  
106 open responses were manually sorted into common themes and other  
107 responses transformed into appropriate form before export to SPSS statistical  
108 software version 19. Descriptive statistics were obtained including frequencies  
109 and proportions with 95% confidence interval for categorical data, whilst  
110 medians, modes, with interquartile ranges (IQR) for continuous and likert  
111 responses. Pearson Chi- squared tests were used to assess associations  
112 between categorical variables and Spearman Rho for correlations. Kruskal  
113 wallis or friedman test were used to analyse variation in likert response levels  
114 and Wilcoxon signed rank sum tests to test statistical significance of variation  
115 between paired categorical data. Influences for average confidence levels  
116 were analysed by fitting independent variables with P values of <0.05 and  
117 potential biological significance into a generalized linear mixed models with  
118 wald chi-square tests of significance. The most parsimonious model was  
119 found by sequential removal of non-significant variables, in order of least  
120 significance. Significance levels for all analyses were set at  $p < 0.05$ .

121

## 122 **Results**

123 *Demographics*

124 Of the 10,268 individuals registered on the equine nutrition course, 1,342  
125 responded to the survey (13% response rate). Respondents were  
126 predominantly (91%) female and in age groups 25-34 (25%) or 45-54 (23%).  
127 Countries of residence covered all continents with Great Britain and Ireland  
128 being most common (32%). The USA, (28%), rest of Europe, (18%) and  
129 Canada (11%) were also common. 39% of respondents listed equine industry  
130 related professions and of these, 83.% were involved equine care and  
131 management, with 48% specifically health care related. Equine management  
132 experience was typically high (25% over 26 years); however, senior equine  
133 management experience was consistently lower ( $Z = -26.810$ ,  $p < 0.0005$ ),  
134 predominantly (24%) 1-5 years (Figure 1). Survey respondents managed a  
135 total of 13,367 equines, of which 28% were senior. Senior breeds most  
136 commonly represented were thoroughbreds and thoroughbred crosses  
137 (21%), followed by ponies (13%) of which the majority (61%) were native to  
138 Britain. Breeds with counts less than 10, not readily categorized within  
139 another group were classified as other (8%). The majority of senior equines  
140 were used mainly for hacking/pleasure purposes (54.%) and retired or  
141 companion animals (43%); however, a large proportion (22.%) were still in  
142 medium to heavy intensity work.

143

144 *Senior equine monitoring and health care provision*

145 Body condition scoring (BCS) was assessed more frequently than weight, but  
146 not significantly so ( $p = 0.053$ ), weight being most commonly assessed  
147 monthly (30%) and BCS weekly (28.%) (Figure 2). A small proportion of the

148 respondents did not assess weight (8%) or BCS (9%). Some respondents did  
149 not know the weight or BCS of their horse, 1.4% and 4.1% respectively. There  
150 was a relationship between amount of senior equine management experience  
151 and frequency of weight ( $p<0.0005$ ) and BCS ( $p=0.010$ ) assessment. Weight  
152 was assessed most commonly by eye (34%), eye in combination with another  
153 technique (32%) or weight tape (25%) (Figure 3). Assessment by eye was  
154 significantly more likely to occur on a regular basis ( $p<0.0005$ ) than tape  
155 ( $p<0.0005$ ) formula ( $p=0.004$ ), or scales ( $p<0.042$ ).

156 Strategic worming was the most frequently used ( $p<0.0005$ ) either on its own  
157 (47.2%) or in combination with either targeted (7.5%) or interval (2%) dosing.  
158 More equine management experience, both in general and of senior equine  
159 particularly, was significantly ( $p<0.0005$ ) associated with using strategic  
160 worming. The use of interval strategies was associated with country  
161 ( $p<0.0005$ ), being most common in North America (59.6%). A minority (1.3%)  
162 reported alternative worming practices, mainly similar to targeted or interval  
163 strategies, but also natural remedies including feeding diatomaceous earth  
164 and faeces removal. Frequency of dental assessment varied significantly  
165 ( $p<0.0005$ ) and was done most often annually (50%) or biannually (27%). No  
166 dental care was reported by 9 respondents (1%). Hoof care was performed  
167 mainly by farriers (62%) ( $p<0.0005$ ) most commonly between 4-6 (36%) or 6-8  
168 (34%) week intervals. Owner-only hoof care (7%) accounted for 52% of those  
169 reporting no farrier care and was significantly associated with overall equine  
170 experience ( $p=0.022$ ), but not respondent profession ( $p=0.920$ ) or senior  
171 experience ( $p=0.582$ ).

172

173 *Senior equine nutrition*

174 Monitoring water intake was performed by 50% of respondents and appeared  
175 to be related to years of experience managing senior equines ( $p < 0.0005$ ).  
176 Water intake was most commonly assessed by monitoring buckets (65%).  
177 Provision of extra forage ( $p < 0.0005$ ) and concentrates ( $p < 0.0005$ ) differed  
178 with season, with highest frequency of respondents giving extra forage (93%)  
179 and concentrates (70%) in winter. Use of supplements did not vary between  
180 seasons ( $p = 0.251$ ), but was also most common done in winter (73%). Hay  
181 was the most commonly fed fibre source, being either grass (78%) or legume  
182 (29%) hay, followed by pasture (66%) and sugar beet pulp (46%). Of those  
183 that reported hay feeding method ( $n = 979$ ), the majority fed it dry (73%), with  
184 others feeding it dampened (15%), soaked (9%), or steamed (3%) (Figure 4).  
185 The majority of respondents (62%) reported feeding grains, pellets, or  
186 concentrates by pre-mixed bags, either commercially and/or locally prepared.  
187 Feeding owner-prepared mixes (23%) was not associated with equine  
188 profession ( $p = 0.487$ ) or experience ( $p = 0.350$ ). A high proportion (86%) of  
189 respondents used supplements, predominantly for providing vitamins or  
190 minerals (78%), whilst salt or electrolytes (46%), joint support (43%), fats and  
191 oils (35%), and hoof care supplements (27%) were also commonly fed.  
192 Respondents most frequently considered senior equine condition to have had  
193 'a lot' of effect on their management (37.3%), whilst 8.9% selected 'not very'.  
194 The aspects of management regime most frequently reported as having  
195 changed since the equine became senior were weight management (40.8%),  
196 supplementation (36.8%) and BCS (33.8%) the latter becoming more frequent  
197 with age ( $p = 0.015$ ). Of those respondents selecting a particular feed brand

198 (83.3%) the most common reasons were: (1) research or knowledge of feed  
199 contents (43.4%); (2) the brand seemed best for the equine after trial (28.7%);  
200 (3) availability of specific senior feed (22.7%).

201

### 202 *Confidence in management regimes*

203 Confidence in implementing management regimes was high overall, with  
204 greatest mean confidence scores for hoof care ( $\mu=4.43$ ), feeding forage  
205 ( $\mu=4.37$ ) and turnout ( $\mu=4.36$ ), and lowest for determining which supplements  
206 to use ( $\mu=3.91$ ) and when to feed those ( $\mu=3.73$ ). 43.7% of 588 respondents  
207 that reported their concerns, cited nutrition related concerns as the aspect of  
208 care that most worried them. Average confidence in regime has a significant  
209 positive association with disease recognition confidence ( $r=0.806$ ,  $p<0.01$ ). A  
210 generalized linear model to explain confidence included equine management  
211 experience, ( $\zeta^2= 95.520$ ,  $p<0.0005$ ), respondent sex ( $\zeta^2 = 14.207$ ,  
212  $p<0.0005$ ), and country ( $\zeta^2 = 12.010$ ,  $p=0.035$ ) with those in South America  
213 ( $\mu=2.78$ ), North America ( $\mu= 2.67$ ) and UK ( $\mu= 2.64$ ) being most confident and  
214 those in Asia ( $\mu= 1.76$ ) being least confident. Importance of advice sources  
215 differed significantly. Veterinarians, scientific publications, books, nutritionists,  
216 dentists, and farriers ranking highest ( $Mdn = 4$ ) and feed stores and television  
217 ranked lowest ( $Mdn = 2$ ). Veterinarians were the information source most  
218 frequently cited as the most important (27.34%).

219

### 220 *Disease experience and disease recognition confidence*

221 Respondents had varying experience of disease management (Figure 5).  
222 Arthritis and loss of body condition were reported as being most prevalent in  
223 senior equines. Confidence in disease recognition varied, but generally  
224 respondents were most confident at recognizing obesity, loss of body  
225 condition, and colic (mode = 5) and least confident at recognizing insulin  
226 resistance, equine metabolic syndrome, and equine grass sickness, (mode =  
227 1) (Figure 6). Those with more experience of managing disease were more  
228 confident in disease recognition ( $p < 0.0005$ ). A generalized linear model, to  
229 explain disease recognition confidence included years experience of equine  
230 management ( $p < 0.0005$ ), diseases experienced ( $p < 0.0005$ ), age ( $p = 0.008$ ),  
231 and sex ( $p < 0.0005$ ) with females being more confident ( $\mu = 2.6$ ) than males ( $\mu =$   
232 2.04).

233

## 234 **Discussion**

### 235 *Responses and bias*

236 | Whilst the sample size (1,342) is large and comparable to other similar  
237 | studies confined to individual countries (Hoffman *et al.*, 2009, McGowan *et al.*,  
238 | 2010a, Ireland *et al.*, 2011), it represents a small proportion of world wide  
239 | equine owners, and response rate of 13% is low. Therefore, generalisation of  
240 | results to the management of the global senior equine population is limited.  
241 | There is also potential for bias given that participants, enrolled on an equine  
242 | studies course, are actively seeking more equine nutrition knowledge and  
243 | may not be representative of the general equine owner population.

### 244 *Demographics*

245 The vast majority of respondents were female, indicating that females might

246 be more likely to seek knowledge or that a larger proportion of equine owners  
247 are female. The predominance of western nationalities, mainly European, may  
248 reflect unequal global availability or advertisement of Coursera courses.  
249 Similarly, the high frequency (40%) of equine professionals that responded  
250 may be attributed to their greater awareness of such courses, but is also a  
251 potential cause for concern that such numbers of equine professionals  
252 (including veterinarians and nutritionists who are traditionally turned to for  
253 nutritional advice), were undertaking an introductory nutrition course.

254 The lack of experience of respondents in managing senior equines was not  
255 unexpected, although the number of senior equines is increasing, the number  
256 of equines in this age group is substantially smaller than 15 years and  
257 younger. In the current study, senior and geriatric equines comprised 28%  
258 and 3% of the population respectively, comparable to American (Brosnahan  
259 and Paradis, 2003a), Australian (McGowan *et al.*, 2010), and British (Ireland  
260 *et al.*, 2011) studies. This indicates senior equines consistently constitute  
261 between a quarter and a third of the global equine population, which highlights  
262 the importance of providing for the specific needs of these animals.  
263 Thoroughbreds or thoroughbred crosses were the most common breed  
264 reported, which concurs with the findings of other studies (Brosnahan and  
265 Paradis, 2003a; McGowan *et al.*, 2010; Ireland *et al.*, 2011). The large  
266 proportion of ponies over 15 also corresponds with other studies in which their  
267 prevalence increased with age (Ireland *et al.*, 2011). The prevalence of senior  
268 equines engaged in medium to high intensity activities is encouraging and,  
269 whilst perhaps influenced by the wide age range used to define senior  
270 equines, also supports that senior equines can lead active lives.

271

272 *Health care provision*

273 Despite dental care, hoof care and worming regimes being important for the  
274 overall health and wellbeing of the equine, it is commonly reported that  
275 provision of such care decreases with equine age (Ireland *et al.*, 2011)  
276 despite evidence that increased provision is advisable (Jarvis, 2009).  
277 Encouragingly, frequent dental and hoof care was reported by many  
278 respondents. There are three common worming strategies; interval, strategic,  
279 and targeted. Interval dosing at set intervals, is not recommended as it  
280 disregards variability in individual equine parasite burden that can lead to  
281 unnecessary overdosing and contribute to drug resistance (Stratford *et al.*,  
282 2013). This is also true of Strategic dosing, which times treatment according  
283 to parasite lifecycle, and can be undermined if environmental conditions lead  
284 to abnormal parasite occurrence (Lester and Matthews, 2014). Targeted  
285 worming is currently advocated in some European countries becoming  
286 legislation in Denmark (Nielsen *et al.*, 2006), the Netherlands and Sweden  
287 (reported by respondents). Treatment is based on individual equine burden by  
288 assessing faecal egg counts (FEC) and refers to parasite lifecycle in  
289 combination with environmental factors (Stratford *et al.*, 2013).

290 Of primary concern with regard to optimal health care therefore was the high  
291 prevalence of strategic worming strategies, also reported by Stratford *et al.*,  
292 (2013), which was associated with more experience of general, and senior  
293 equine management. The requirement for potentially expensive FEC may  
294 explain the lower occurrence of targeted regimes and why strategic regimes

295 maybe favoured as an easier alternative to the now less advised interval  
296 regime. Stratford *et al*, (2013), proposed that an increase in FEC was  
297 associated with higher levels of veterinary involvement, indicating a  
298 requirement for increased veterinary input, either by targeting better worming  
299 regime advice, or facilitating access to FEC analysis. A number of  
300 respondents reported using natural wormers, most often diatomaceous earth,  
301 the fossilized remains of algae or diatoms (Bernard *et al.*, 2009). However,  
302 whilst these alternatives maybe perceived as preferable to the administration  
303 of chemical anthelmintics, they could potentially cause more harm than good  
304 if they are not effective in combating parasitic infection. Particularly given the  
305 potential consequences of parasitic infection on senior equine digestive  
306 function (Ralston *et al.*, 2001). Further scientific testing of the efficacy of such  
307 preparations in equines is therefore required, particularly given the evidence  
308 suggesting that diatomaceous earth is ineffective at combating parasite  
309 infection in other species (Bernard *et al.*, 2009).

310

### 311 *Nutrition*

312 Good quality safe feeds are essential for optimum nutrition. Readily digested  
313 forage sources including pasture, sugar beet pulp, and hay cubes were  
314 common, perhaps reflecting adjustments in response to dental degeneration,  
315 but hay was still the most commonly fed forage, despite being more  
316 problematic for older horses to chew.

317 Selecting good quality hay, produced and stored correctly to maximize quality  
318 is of primary importance for best nutrition. Treating hay by dampening or

319 soaking is recommended by some to remove dust that can exacerbate RAO  
320 (Pirie, 2013), but can result in loss of nutrients whilst, streaming can  
321 additionally combat spoilage organisms with minimal nutrient loss. Most  
322 respondents fed hay dry, as found in other studies (Hotchkiss *et al.*, 2007),  
323 perhaps awareness of hay treatment is low, supported by equine related  
324 professionals and experience of RAO making it more likely. Therefore  
325 promoting awareness of RAO and the potential benefits of hay treatment,  
326 could increase the prevalence of appropriate hay feeding. Selection of feeds  
327 based on composition or suitability for the senior equine demonstrates an  
328 encouraging and concerted effort to select the best feed for equine  
329 requirements and a knowledge of nutrition to do so. This may have been more  
330 evident in the study sample given their proactive search for knowledge  
331 demonstrated by their enrolment on an equine nutrition course.

332 Supplements were the element of nutrition most commonly reported as  
333 changing since the equine had become senior. Similar to other studies of both  
334 all equines (Hoffman *et al.*, 2009) and senior equines specifically (McGowan,  
335 2010), joint and vitamin/mineral supplements usage were most prevalent.  
336 Many also reported to use vitamin supplementation and certainly vitamins  
337 have been purported to be beneficial for senior equines, including the  
338 antioxidant vitamin E, which has been reported to delay aging and reduce  
339 inflammation (Siciliano, 2002). However, equine supplement requirements are  
340 a fairly recent addition to equine nutrition and have had minimal research and  
341 respondents may be unfamiliar with the variety and applications of available  
342 supplements. In addition, evidence for efficacy and safety of supplements is  
343 therefore lacking which creates doubt about advocating their use as they can

344 cause nutritional imbalances and be as detrimental as lack of  
345 supplementation (Brosnahan and Paradis, 2003a; Hoffmann *et al.*, 2009).  
346 Therefore high supplement use on its own does not necessarily imply optimal  
347 equine care and further research is required to support the use and selection  
348 of supplements, and perhaps there is a case for professional involvement to  
349 help advise owners to promote the use of the right supplement at the right  
350 time. Fewer respondents reported feeding supplements associated with  
351 senior diseases including equine metabolic syndrome, respiratory health and  
352 insulin resistance, which whilst this may reflect a lack of requirement it may  
353 also represent an under recognition of these conditions.

354 Water is an essential element of equine digestion and waste product excretion  
355 through the kidneys and dehydration can lead to many complications  
356 including impaction colic (Frape, 2010), yet despite this water consumption it  
357 is often overlooked as part of equine nutrition. The finding that over half of  
358 respondents did not monitor water consumption is perhaps therefore not  
359 surprising, but no less concerning. Difficulty in monitoring from automatic  
360 waterers or when equines are kept in groups, were reasons stated by some  
361 respondents. Monitoring consumption from buckets, most common among  
362 respondents, is an accurate, and hence optimal, indication of equine hydration  
363 (Pritchard *et al.*, 2010). Indirect assessment including equine excretions and  
364 physical state might be advocated suitable alternative for those who find  
365 bucket monitoring impracticable as reported by a number of respondents.  
366 However, an indirect assessment, the skin tent test, does not reliably indicate  
367 dehydration (Pritchard *et al.*, 2010) neither does it monitor variation in water  
368 consumption which can be an indicator of disease, for instance excessive

369 thirst can indicate Cushing's disease (Equine Hyperadrenocorticism) (Geor,  
370 2007). Thus, attempting to observe equine drinking behaviour, as often as  
371 possible, for instance after exercise, maybe a feasible alternative to bucket  
372 monitoring. Whilst it remains the responsibility of the equine carer to  
373 familiarise themselves with their animals normal thirst level, an increased  
374 emphasis of the importance of water consumption from health professionals is  
375 required.

376

### 377 *Physical assessment*

378 Equine body weight estimates are required to calculate nutritional  
379 requirements and medical doses including anthelmintics. Furthermore, body  
380 weight and condition are useful indicators of health status, for example non-  
381 optimal weight and fat deposition in specific bodily regions can predispose  
382 equines to diseases including laminitis (Alford *et al.*, 2001) and ECD (Durham  
383 *et al.*, 2014). Altered physical condition can indicate the efficacy of a change  
384 in regime (Geor and Harris, 2009) or the occurrence of disease, for example  
385 chronic weight loss is the primary clinical sign for mal-absorption (Mair *et al.*,  
386 2006). Therefore, it is recommended that weight and body condition scores  
387 are determined on a regular (2-4 weekly) basis, (Geor and Harris 2009) to  
388 monitor any change, which is particularly important for senior equines. Whilst  
389 frequency (daily-weekly) assessment was conducted by a significant  
390 proportion of respondents in the current study, an equally large proportion  
391 reported monthly or less frequent assessment, and a small, but important,  
392 number never carrying out or knowing what either assessment was. This

393 might reflect a perceived lack of importance by those respondents for weight  
394 assessment, or indeed any focused assessment of equine condition, which  
395 might potentially contribute to the lack of disease recognition found in other  
396 studies (Ireland *et al.*, 2012). Those assessing weight did so with a  
397 combination of techniques, predominantly by eye, and assessments were  
398 likely to be more frequent with this method. However, visual assessment is  
399 considered less accurate than other techniques (tape/formula) and monitoring  
400 changes is difficult. Formulas are generally considered the more accurate  
401 estimation than using weigh tapes (Wager and Tyler, 2011), whilst weigh  
402 bridges are most accurate. However, accuracy depends on the type of  
403 formula or indeed tape used and also the type of equine assessed (Reavell,  
404 1999). Reavell, (1999) found tapes more effective for thoroughbred types  
405 whilst the Carroll and Huntington formula (Carroll and Huntington, 1988) was  
406 best for small ponies. Requirements for 'specific' equipment or apparently  
407 complicated procedures may cause tapes, formulas, and body condition  
408 scoring to be perceived as difficult. Addressing this issue may require more  
409 that just increasing awareness of the need to conduct such assessment. One  
410 potential measure may be to utilise the expanding applications of technology,  
411 for instance specific apps that are designed to help make formula use and  
412 BCS easier, and which may increase confidence and therefore encourage  
413 more frequent condition assessment. Although this does require the use of  
414 technology and is hence not inclusive to all.

415

416 *Confidence in management regime*

417 Overall respondents reported high confidence in management regimes,  
418 although it must be remembered that this does not necessarily indicate  
419 knowledge or that the regimes were appropriate. Respondent sex significantly  
420 influenced confidence, with females being more confident than males.  
421 Females may be more intrinsically confident in equine managements for a  
422 variety of reasons Lenney, (1977) but males may have had lower experience  
423 and as a consequence reported lower confidence. Respondents from western  
424 countries appeared more confident than elsewhere. This may be linked to  
425 preponderance of equine research in western countries thus providing them  
426 with more information to base management decisions on. There is perhaps  
427 therefore a need for research on equine requirements in other countries to  
428 increase available information.

#### 429 *Disease experience and respondent confidence*

430 The majority of diseases for which respondents were asked to report their  
431 experience and confidence are commonly associated with senior equine age  
432 and therefore unsurprising the majority were most commonly experienced in  
433 senior equines compared to non-senior. This supports the assertion that  
434 equines are increasingly predisposed to such disease with senescence. Less  
435 experienced conditions including insulin resistance, equine metabolic  
436 syndrome, cataracts, and diabetes may reflect both their rarity and lower  
437 average experience of senior equine management by survey respondents,  
438 given that they occur more frequently in older equines (Chandler *et al.*, 2003).  
439 However, it may also indicate under recognition, found elsewhere (Chandler  
440 *et al.*, 2003, Ireland *et al.*, 2012). Laminitis and obesity were common in both  
441 senior and non-senior equines. There is much advice relating to these

442 conditions due to their prevalence, the potential severity of laminitis, and  
443 consequences of obesity resulting in heightened awareness that may explain  
444 the high confidence in laminitis and obesity recognition. However, the  
445 prevalence of essentially preventable diseases indicates that whilst  
446 respondents can recognise them, they are less able to anticipate and prevent  
447 them. The reported lack of frequent weight and BCS determination by  
448 objective measures in this study highlights an area that could be improved to  
449 potentially help combat these issues and indicates that current methods to  
450 increase awareness are not entirely effective.

451 Greater confidence in disease recognition was associated with greater  
452 confidence in management regimes. If confidence indicates a certain level of  
453 competence, then perhaps those better at recognising disease are  
454 consequently better able to formulate appropriate management. This  
455 suggests education in the diseases of senior equines will have a positive  
456 impact on all areas of their care. Whilst this is an assumption, it is supported  
457 by the association between experience and confidence. Average confidence  
458 in disease recognition was increased with more years of equine management  
459 experience, more diseases experienced, being older, and being female. The  
460 association between disease/management experience, and disease  
461 recognition confidence highlights a need to target education of diseases,  
462 particularly those that are rarer, to owners that have less experience. This is  
463 not to say that those with greater experience may not benefit from education  
464 to consolidate and expand their knowledge of new developments. Senior  
465 equine management experience, however did not significantly influence  
466 disease recognition confidence. This could be due to correlation with overall

467 equine experience so that it had no additional effect on the statistical model.  
468 However, it suggests that senior equine management does not imply  
469 experience of age-associated diseases, perhaps due to the rarity of some  
470 diseases, or that they are more prevalent equines in the higher end of the age  
471 bracket used and not all respondents would have had experience of  
472 managing equines of this age. This indicates all carers of senior equines  
473 (aged 16 and over) irrespective of experience, would benefit from information  
474 on rare, age associated diseases.

#### 475 *Sources of Advice*

476 Veterinarians were rated highest in terms of important sources of nutritional  
477 advice, which concurs with the findings of other studies (Hoffman *et al.*, 2009).  
478 However, there is some concern over the ability of veterinarians to offer up to  
479 date nutritional advice, specifically with respect to senior equines. Veterinary  
480 nutritional education is minimal and the profession requires a broad  
481 knowledge base making it difficult to keep abreast of advancements in every  
482 field and indeed, perceive their own knowledge to be suboptimal (Roberts and  
483 Murray, 2013). This is possibly the reason why there were a number of  
484 veterinary surgeons, nurses, and technicians enrolled on this introductory  
485 equine nutrition course. Nutritionists also featured highly as sources of advice,  
486 | which is encouraging as they can provide specific nutritional support.  
487 However, in a study asking respondents which advice sources they actually  
488 use, nutritionists ranked seventh, below vet, trainer, feed store, book, Internet,  
489 and magazine (Hoffmann *et al.*, 2009). This indicates that the perceived  
490 importance of a source does not necessarily reflect its use. For nutritionists

491 this may reflect inaccessibility or cost, but nevertheless highlights a need to  
492 promote their services. Encouragingly, scientific publications and books  
493 featured highly, again indicating an active effort for respondents to seek their  
494 own information, although as previously discussed, this may have been  
495 skewed by the fact that respondents were enrolled on an education course,  
496 and hence not representative of the general equine carer population. The  
497 majority of respondents reported using multiple sources, which has also been  
498 found elsewhere (Hoffman *et al.*, 2009). Whilst this may allow a more  
499 comprehensive and balanced knowledge base from which to make  
500 appropriate management decisions, which is advisable, many sources  
501 particularly those available on the internet, are not based on scientific  
502 evidence and may contradict each other. As individuals are only likely to  
503 increase their use of the Internet for their own research, it is imperative that  
504 reliable and adjudicated sources of information are promoted. As Roberts and  
505 Murray (2013) suggest being able to direct their clients to these sources may  
506 be where the role of veterinarians could lie in the future. Finally, given the  
507 increasing use of the internet and the evident popularity of the nutrition course  
508 on which respondents were enrolled, perhaps increased provision of online  
509 courses would be beneficial. Not only do such course offer the potential to  
510 deliver reliable and accurate information that can be retained for future  
511 reference, they can also provide an opportunity for assessment, offering  
512 feedback on performance that can increase confidence (Lenney, 1977), and  
513 the opportunity to engage with professional lecturers to address personal  
514 areas in which confidence is lacking.

## 515 **Conclusion**

516 In general respondents were highly confident in many aspects of senior  
517 equine management, which overall indicated a high level of care provision  
518 and effort to fulfil equine welfare and nutritional needs. However, low  
519 confidence in feeding supplements highlights a need for education in their  
520 applications and continued scientific investigation of their uses and efficacy.  
521 Furthermore despite high overall confidence, various findings indicate a  
522 requirement for continued owner education in best management practices,  
523 particularly optimal worming strategies, hay feeding, water consumption, and  
524 body condition monitoring. Low confidence in disease recognition, particularly  
525 those common in senior equines, highlights a need for information exchange  
526 between veterinarians and owners, particularly those with least experience.  
527 Veterinarians were perceived as the most important advice source and are  
528 therefore integral to increasing the knowledge and confidence of equine  
529 owners and carers.

530

### 531 **Acknowledgements**

532 Many thanks to Chrissy Coakley, Dr Nick Colegrave, and Dr Matt Bell for their  
533 statistical advice and to the participants who made this study possible.

534

### 535 **References**

536

537 Adams AA, Katepalli MP, Kohler K, Reedy SE, Stilz JP, Vick MM, Fitzgerald BP,  
538 Lawrence LM and Horohov DW 2009. Effect of body condition, body weight  
539 and adiposity on inflammatory cytokine responses in old horses. *Vet.*  
540 *Immunol. Immunopathol.* 127, 286-294.

541

542 Alford P, Geller S, Richrdson B, Slater M, Honnas C, Foreman J, Robinson J, Messer  
543 M, Roberts M, Goble D, Hood D and Chaffin M 2001. A multicenter, matched  
544 case-control study of risk factors for equine laminitis. *Prev. Vet. Med.* 49, 209-  
545 222.

546 Bernard G, Worku M and Ahmedna M 2009. The Effects of *Diatomaceous* Earth on  
547 Parasite Infected Goats. *Bull. Georg. Natl. Acad. Sci.* 3(1), 129-135.

548

549 Brosnahan MM and Paradis MR 2003a. Demographic and clinical characteristics of  
550 geriatric horses: 467 cases (1989-1999). *J. Am. Vet. Med. Assoc.* 223, 93-98.

551

552 Carroll CL and Huntington PJ 1988. Body condition scoring and weight estimation of  
553 horses. *Equine Vet. J.* 20, 41-45.

554

555 Chandler KJ, Billson FM and Mellor DJ 2003. Ophthalmic lesions in 83 geriatric  
556 horses and ponies. *Vet. Rec.* 153, 319-322.

557

558 Durham AE, McGowan CM, Fey K, Tamzali Y and van der Kolk JH 2014. Pituitary  
559 pars intermedia dysfunction: Diagnosis and treatment. *Equine Vet. Education.*  
560 | 26(4). 216-223.

561

562 Elzinga S, Nielsen B, Schott H, Rapson J, Robison C, McCutcheon J, Harris P and  
563 Geor R 2011. Effect of Age on Digestibility of Various Feedstuffs in Horses. *J.*  
564 | *Equine Vet. Sci.* 31. 268-269.

565 Frape D 2010. *Equine Nutrition and Feeding*. 4<sup>th</sup> ed. Markono Print Media Pte Ltd,  
566 | Singapore: Wiley-Blackwell.

567

568 Geor RJ 2007. Cushing's disease and other problems of the older horse. In: Pagan  
569 JD, editor. Advances in equine nutrition III. Nottingham, UK: Nottingham  
570 University Press. pp:447-452.  
571

572 Geor RJ and Harris P 2009. Dietary Management of Obesity and Insulin Resistance:  
573 Countering Risk for Laminitis. Vet. Clin. N. Am: Equine Pract. 25, 51-65.  
574

575 Hoffman CJ, Lais BS, Costa R and Freeman LM 2009. Survey of Feeding Practices,  
576 Supplement Use, and Knowledge of Equine Nutrition among a Subpopulation  
577 of Horse Owners in New England. J. Equine Vet. Sci. 29, 719-726.  
578

579 Hotchkiss JW, Reid SWJ and Christley RM 2007. A survey of horse owners in Great  
580 Britain regarding horses in their care. Part 1: Horse demographic  
581 characteristics and management. Equine Vet. J. 39, 294-300.  
582

583 Ireland JL, Clegg PD, McGowan CM, McKane SA and Pinckbeck GL 2011. A cross-  
584 sectional study of geriatric horses in the United Kingdom. Part 1:  
585 Demographics and management practices. Equine Vet. J. 43, 30-36.  
586

587 Ireland JL, McGowan CM, Clegg PD, Chandler KJ and Pinchbeck GL 2012. A survey  
588 of health care and disease in geriatric horses aged 30 years or older. The  
589 Vet. J. 192, 57-64.  
590

591 Jarvis NG 2009. Nutrition of the Aged Horse. Vet. Clin. N. Am: Equine Pract. 25:155-  
592 156.  
593

594 Lenney E 1977. Women's self-confidence in Achievement settings. Psycho. Bull. 84,  
595 1-13.

596 Lester HE and Matthews JB 2014. Faecal worm egg count analysis for targeting  
597 anthelmintic treatment in horses: Points to consider. *Equine. Vet. J.* 46, 139-  
598 145.  
599

600 Mair TS, Pearson GR and Divers TJ 2006. Malabsorption syndromes in the horse.  
601 *Equine Vet. Educ.* 18, 299-308.  
602

603 McGowan TW, Pinchbeck G, Philips CJC, Perkins N, Hodgson DR and McGowan  
604 CM 2010. A survey of aged horses in Queensland, Australia. Part 1:  
605 management and preventative health care. *Aust. Vet. J.* 88, 420-427.  
606

607 Nielsen MK, Monrad J and Olsen SN 2006. Prescription-only anthelmintics—A  
608 questionnaire survey of strategies for surveillance and control of equine  
609 strongyles in Denmark. *Vet. Parasitol.* 135, 47-55.  
610

611 Pirie RS 2013. Recurrent airway obstruction: A review. *Equine Vet. J.* DOI:  
612 10.1111/evj.12204, 1-13.  
613

614 Pritchard JC, Burn CC, Barr ARS and Whay HR 2010. Validity of indicators of  
615 dehydration in working horses: A longitudinal study of changes in skin tent  
616 duration, mucous membrane dryness and drinking behaviour. *Equine Vet. J.*  
617 40, 558-564.

618 Ralston SL, Malinowski K, Christensen R and Breuer L 2001. Digestion in aged  
619 horses-revisited. *J. Equine. Vet. Sci.* 21(7), 310-311.  
620

621 Reavell DG 1999. Measuring and estimating the weight of horses with tapes,  
622 formulae and by visual assessment. *Equine Vet. Educ.* 11, 314- 317.  
623

624 Roberts JL and Murray J 2013. Survey of Equine nutrition: Perceptions and Practices  
625 of Veterinarians in Georgia, USA. J. Equine Vet. Sci. 33, 454-459.

626

627 Siciliano PD 2002. Nutrition and feeding of the geriatric horse. Vet. Clin. N. Am:  
628 Equine Pract. 18, 491-508.

629

630 Stratford CH, Lester HE, Morgan ER, Pickles KJ, Relf V, McGorum BC and  
631 Matthews, J.B. 2014. A questionnaire study of equine gastrointestinal parasite  
632 control in Scotland. Equine Vet. J. 46, 25-31.

633

#### 634 **Figure captions**

635 **Figure 1** Percent of respondents reporting different amounts of equine  
636 management experience in years, both overall (grey bars) (n=1334) and for  
637 senior equines specifically, (e16 years) (white bars) (n=1259).

638

639 **Figure 2** Frequency of weight assessment (black bars) and Body condition  
640 scoring (white bars) reported by respondents (n=732). No significant  
641 difference in frequency of weight or BCS ( $Z=-1.933$ ,  $p=0.053$ )

642 **Figure 3** Frequency of weight assessment methods reported by respondents  
643 (n=732). Some respondents represented more than once. Other includes  
644 photographs and monitoring when doing up the girth.

645 **Figure 4** Frequency of different hay feeding methods reported by respondents  
646 that fed hay (n=1011). Respondents could select multiple responses and  
647 could therefore be represented more than once.

648 **Figure 5** Number of respondents (n= 967) reporting experience of various age  
649 associated conditions or diseases in senior and non-senior equines.  
650 Experience of conditions was significantly greater in senior and conditions  
651 differed in their prevalence. ECD (Equine Cushing's disease), DJD  
652 (degenerative joint disease), EGS (equine grass sickness), EMS (equine  
653 metabolic syndrome), IR (Insulin resistance), LBC (Loss of body condition),  
654 RAO (respiratory airway disease).

655 **Figure 6** Respondent confidence of recognizing age associated conditions  
656 and diseases, reported on a likert scale from 1 (not at all) to 5 (very) (n=1043).  
657 ECD (Equine Cushing's disease), DJD (degenerative joint disease), EGS  
658 (equine grass sickness), EMS (equine metabolic syndrome), RAO (respiratory  
659 airway disease).

660