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1 COLIC IN THE BRITISH MILITARY WORKING HORSE POPULATION - A RETROSPECTIVE

2 ANALYSIS

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4 V.J. Tannahill BVMS CertAVP(EP)(VDI) MRCVS

- 5 Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Hertfordshire AL9 7TA, United
- 6 Kingdom.
- 7 * Current Address: Weipers Centre Equine Hospital, School of Veterinary Medicine, University of
- 8 Glasgow, Bearsden Road, Bearsden, Glasgow G61 1QH.
- 9 victoria.tannahill@glasgow.ac.uk Tel: 0141 330 5999 Fax: 0141 330 6025
- 10

11 J.M. Cardwell MA VetMB MSc(VetEd) PhD FHEA MRCVS

- 12 Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Hertfordshire AL9 7TA, United
- 13 Kingdom.
- 14

15 T.H. Witte BVetMed PhD FHEA DipACVS DipECVS MRCVS

- 16 Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Hertfordshire AL9 7TA, United
- 17 Kingdom.
- 18
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22 ABSTRACT

23 Colic is a common and potentially life-threatening condition of horses. Multiple risk factors have been previously identified and it is known that a careful management routine can help to reduce colic rates. 24 The British military working horse population represents a unique cohort of horses that are 25 26 intensively managed with a strict regimen. This retrospective study examined the incidence and mortality rate of colic within this population, as well as the signalment of affected horses, and 27 28 compared these with the general population. Data for 717 horses over a five-year period (2008-29 2012) were analysed. Of these, 163 horses (22.7%) experienced 267 colic episodes and thirteen 30 horses (1.8%) died because of colic. Recurrent colic was experienced by 35% (57/163) of horses. 31 The incidence of colic was 11.1 episodes per 100 horse years and of colic-related death was 0.5 32 deaths per 100 horse years. Horses purchased from mainland Europe were more likely to suffer 33 from colic (OR4.6; P<0.001) and from recurrent colic (OR6.0; P=0.005) than horses purchased from 34 Ireland. Only 3% (8/267) of colic episodes were treated surgically. It was concluded that the incidences of colic and colic-related deaths within the British military working horse population are 35 36 similar to those of the general horse population.

37 INTRODUCTION

Colic is an extensively described clinical syndrome in horses – numerous epidemiological studies
 have described the age, sex and breed of horses suffering from colic, as well as the incidence and
 mortality rate.¹⁻⁸ Further studies have evaluated the risk factors for colic including housing, feeding,
 exercise and veterinary factors.^{3-4,7,9-14}

42

There are few studies investigating veterinary problems amongst military working horses. Putnam et al^{15} recently described lameness within one subset of the British population while Laranjeira et al^{16} detailed colic within a Brazilian population.

46

47 The British military working horse population represents a unique cohort of horses that are 48 intensively managed with strict regimens. They are divided into three distinct populations - the 49 Defence Animal Centre (DAC), the Household Cavalry Mounted Regiment (HCMR), and the King's 50 Troop Royal Horse Artillery (KTRHA). Horses are routinely stabled or stalled, undertake a minimum 51 of an hour of exercise on six days per week, and have a period of pasture rest for several weeks at 52 least once yearly. Roughage (hay or haylage) and concentrate feeding (generally chaff and fibre 53 nuts) are tailored to each individual horse's needs based on their exercise intensity and body 54 condition. All horses have access to fresh water from an automatic drinker or bucket when stabled 55 or stalled, and from a water trough when grazing. Stabling consists of a loose box where the horse 56 may move around freely. Stalling consists of an area where the horse is tethered by a headcollar and retractable rope such that it may reach the floor to eat or drink, may lie down or may reach round 57 to groom itself, but it may not turn around completely within the stall. They are routinely vaccinated 58 59 against equine influenza and tetanus, and regularly de-wormed following a military-wide, rotational, 60 synchronized anthelmintic schedule. Dental examinations and treatment are conducted annually by a veterinary surgeon or registered equine dental technician; those horses that require more frequent 61 62 treatment are afforded this as necessary. Veterinary care at each site is provided by a dedicated 63 veterinary surgeon and veterinary technician. All personnel involved in horse care are given regular 64 instruction regarding the signs of colic and the immediate action to be taken for cases of suspected 65 colic.

66

There are several features of the British military horse's regimen that may contribute to an increased risk of colic; for example, stalling and reduced access to pasture,¹¹ exercising more than once per week¹⁰ and having more than one care-giver.^{2,12} There are also some features of their management that could contribute to a reduced colic rate; for instance, regular anthelmintic treatment and careful dietary changes.¹⁰⁻¹¹

72

The aims of this retrospective cohort study were to describe the incidence and mortality rate of colic within the British military working horse population, as well as the signalment of those horses suffering from colic, and to compare these outcomes to the general horse population.

76 MATERIALS AND METHODS

77 Ethical approval for the retrospective collation of data from clinical records was obtained from the 78 Royal Veterinary College's Social Science Research Ethical Review Board. Permission to collate 79 and analyse the data was obtained from the Director Army Veterinary and Remount Services prior 80 to the start of the study. Data from the clinical records of horses that undertook military work at any time between 1st January 2008 and 31st December 2012 were recorded. Records of those horses 81 82 that remained in military work were accessed from the veterinary clinics of the three populations. 83 Records of horses that concluded their military work (either through retirement, euthanasia or death) 84 during the study period were accessed from archived records.

85

86 Details of the horses' year of birth, sex, breed, country of purchase and population subset were 87 recorded. Country of purchase was categorised as: 'Ireland', meaning Northern Ireland and Republic 88 of Ireland; 'GB' (Great Britain), meaning England, Scotland and Wales; and 'Europe', meaning 89 mainland Europe. Population subset was categorised as: 'DAC' (Defence Animal Centre), 'HCMR' 90 (Household Cavalry Mounted Regiment), or 'KTRHA' (King's Troop Royal Horse Artillery). Each 91 horse's total time at risk during the study period (months) was calculated from its date of entry into 92 and date of exit from military work; for ease of calculation, one month was counted for each whole 93 month or part thereof that the horse was in military work. The number of colic episodes suffered by 94 the horse during the study period, and if the horse died or was euthanased because of colic, were 95 recorded. A horse was deemed to have suffered from a colic episode if either: a) an event of 'colic' 96 was recorded by the attending veterinary team, or b) clinical signs of colic including, but not limited 97 to, rolling, pawing, flank watching, kicking the abdomen or prolonged recumbency, with or without 98 reduced faecal output or reduced appetite, were recorded by the attending veterinary team. A colic 99 episode was deemed to have resolved when either: a) the veterinary team recorded that the horse had 'returned to normal' or was 'discharged', or words to that effect, or b) when ≥48 hours had 100 101 passed before the next entry was made in the clinical record. For each colic episode, the month and 102 year of the episode, as well as the age of the horse at the time of the episode, and the treatment 103 received (medical or surgical), were recorded. Age (in years) was calculated on the assumption that each horse was born on January 1st of its birth year, and the month of the colic episode was counted 104

105 as a whole month regardless of the day the colic episode occurred. Horses were deemed to have 106 died of colic when the clinical signs of colic directly preceded death. Horses were deemed to have 107 been euthanased due to colic when the veterinary surgeon's decision to euthanase the horse was 108 directly related to the colic episode.

109

110 Colic episodes were defined as being recurrent if \geq 48 hours passed between colic episodes, during 111 which time no further abnormalities that may be associated with colic were recorded. The time at 112 risk (months) for horses with recurrent colic was calculated from the date of the first episode of colic 113 until the date of exit from military work.

114

115 Data were analysed using Stata® version 13 (StataCorp LP, College Station, Texas, USA). 116 Categorical variables (sex, country of purchase, population subset, month, year, treatment) were summarised using number and percentage. Incidence rates were calculated by dividing the number 117 118 of episodes or deaths by the total time at risk (years) and multiplying by 100. Relationships between 119 sex, country of purchase and population subset of horses suffering from colic and recurrent colic 120 were examined using cross-tabulations and tested for significance using a univariable logistic 121 regression model. Variables with a univariable *P*-value of <0.1 were taken forward to multivariable 122 analysis. Models were built using a manual forward step-wise approach, with a likelihood ratio test 123 value of P<0.05 used as the threshold for retention. Outliers were checked for data entry errors and 124 retained in the model. It was considered that there were no biologically plausible interactions. The final fit of the final model was tested using the Hosmer-Lemeshow goodness-of-fit test. Exact 125 (Clopper Pearson) 95% confidence internals were calculated around morbidity and mortality 126 127 estimates. Continuous variables (time at risk, total colic episodes, age) were tested for normality 128 using the Shapiro-Wilk test and were not found to follow a normal distribution. These were 129 summarised using median, minimum and maximum values. Significance was set at P<0.05.

130 **RESULTS**

131 A total of 766 horses were identified as being in military work during the study period however 49 clinical records, representing 6.4% of the eligible horses, were inaccessible and so were excluded 132 133 from the study. Of the 717 horses that were included, 505 (70.4%) were geldings, 211 (29.4%) were 134 mares and one (0.1%) was a colt. A total of 35 different horse breeds were recorded and 493 (68.8%) 135 horses had no breed listed. The three most common horse breeds were Irish Sport Horse and 136 associated cross-breeds (n=115; 16.0%), Irish Draught and associated cross-breeds (n=34; 4.7%) 137 and KWPN (n=12; 1.7%). The majority of horses (n=511; 71.3%) were purchased from Ireland, 181 138 (25.2%) were from GB and 25 (3.5%) were from elsewhere in mainland Europe. Just over half 139 (n=378; 52.7%) of horses were from the HCMR, 176 (24.5%) were from the KTRHA and 163 (22.7%) 140 were from the DAC. The total time at risk was 28,750 months (2395.8 years; range 1-60) and 266 141 (37.1%) horses were at risk for the entire study period (60 months).

142

143 A total of 163 (22.7%; 95%CI 19.7-26.0) horses suffered colic during the study period and there were 144 267 colic episodes in total. The majority of horses (n=106; 65.0%) that suffered colic only had one 145 episode during the study period. The maximum number of episodes suffered by any horse was 146 thirteen (Figure 1). The incidence of colic was 11.1 episodes per 100 horse years. The median age 147 of horses experiencing a colic episode during the study period was 9.8 years (range 3.7-23.8). The 148 number of colic episodes per month and per year are shown in Figure 2. Most colic episodes (n=259; 149 97.0%) were treated by medical means while eight (3.0%) cases underwent surgical treatment. 150 Univariable and multivariable relationships between recorded variables and occurrence of colic are 151 summarised in Table 1.

152

153 **Table 1 – Univariable and multivariable associations with occurrence of colic in a**

154 population of British military working horses (n=717).

Colic					Univariable		Multivariable				
		No		Yes		Crude	95% CI	P valuo	Adjusted	95% CI	D value
		n	%	n	%	OR	93 /8 CI	F-value	OR	95 /8 CI	F -value
Sex	Male	389	76.9	117	23.1	ref				-	-
	Female	165	78.2	46	21.8	0.9	0.6 – 1.4	0.7			
Country of Purchase	Ireland	399	78.1	112	21.9	ref			ref		
	GB	143	79.0	38	21.0	0.9	0.6 – 1.4	0.8	1.1	0.7 – 1.7	0.7
	Europe	12	48.0	13	52.0	3.9	1.7 – 8.7	0.001	4.6	2.0 – 10.5	<0.001

	HCMR	279	73.8	99	26.2	ref			ref		
Population	KTRHA	142	80.7	34	19.3	0.7	0.4 – 1.0	0.08	0.6	0.4 – 1.0	0.08
	DAC	133	81.6	30	18.4	0.6	0.4 – 1.0	0.05	0.6	0.4 – 0.9	0.02

155 OR = odds ratio. CI = confidence interval. Ref = reference variable.

156

157 Fifty-seven horses (35%; 95%CI 27.7-42.8) suffered from recurrent colic and they experienced 104 158 episodes of colic. The total time at risk was 1901 months (238.5 years; range 2-60). The incidence 159 of recurrent colic was 65.7 episodes per 100 horse years. The median age of horses experiencing 160 a recurrent colic episode during the study period was 8.8 years (range 5.8-21.4). The number of 161 recurrent colic episodes per month and per year are shown in Figure 3. Most recurrent colic episodes 162 (n=100; 96.2%) were treated medically however four (3.8%) cases underwent surgical treatment. 163 Univariable and multivariable relationships between recorded variables and occurrence of recurrent 164 colic are summarised in Table 2.

165

166 Table 2 – Univariable and multivariable associations with occurrence of recurrent colic in a

Population of British minitary working holdes suffering nom cone (n=10)	suffering from colic (n=163).	working horses suffering	population of British militar	167
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Recurrent Colic				Univariable			Multivariable				
		No		Yes		Crude	95% CI	P-value	Adjusted	95% CI	P-value
		n	%	n	%	OR			OR		
Sex Country of Purchase	Male	81	69.2	36	30.8	ref			ref		
	Female	25	54.3	21	45.7	1.9	0.9 – 3.8	0.08	2.2	1.0 – 4.5	0.04
	Ireland	78	69.6	34	30.4	ref			ref		
	GB	24	63.2	14	36.8	1.3	0.6 – 2.9	0.5	1.4	0.6 – 3.1	0.4
	Europe	4	30.8	9	69.2	5.2	1.5 – 17.9	0.01	6.0	1.7 – 21.4	0.005
Population	HCMR	68	68.7	31	31.3	ref					
	KTRHA	20	58.8	14	41.2	1.5	0.7 – 3.4	0.3			
	DAC	18	60.0	12	40.0	1.5	0.6 – 3.4	0.4			

168 OR = odds ratio. CI = confidence interval. Ref = reference variable.

169

170 Thirteen horses died or were euthanased due to colic during the study period giving an overall 171 mortality rate of 1.8% (95%CI 1.0-3.1) in the entire study population (n=717) and an incidence of 0.5 172 deaths per 100 horse years. Amongst those horses experiencing a colic episode (n=163), the 173 mortality rate was 8.0% (95%CI 4.3-13.2). Nine horses (69.2%) were geldings and four (30.8%) were 174 female. The majority (n=11; 84.6%) were purchased from Ireland with only one (7.7%) from GB and 175 one (7.7%) from the rest of mainland Europe. Most (n=11; 84.6%) were from the HCMR with only 176 one horse (7.7%) from each of the KTRHA and DAC. The median age of horses dying from colic 177 during the study period was 12.5 years (range 5.7-21.8).

178

179 Seven horses with recurrent colic died or were euthanased during the study period giving an overall mortality rate of 1.0% (95%CI 0.4-2.0) in the entire study population (n=717). Amongst those horses 180 181 experiencing recurrent colic episodes (n=57), the mortality rate was 12.3% (95%CI 5.1-23.7) and 182 the incidence was 4.4 deaths per 100 horse years. There were four female horses (57.1%) and three 183 geldings (42.9%). The majority of horses (n=6; 85.7%) were from Ireland with only one (14.3%) from 184 GB. Most (n=6; 85.7%) were from the HCMR with only one (14.3%) from the KTRHA. The median 185 age of horses dying from recurrent colic during the study period was 14.2 years (range 8.1-17.8). 186 187 Seven out of eight horses (87.5%; 95%CI 47.3-99.7) that underwent surgery at an equine referral 188 hospital were euthanased, including all four horses undergoing surgical treatment for recurrent colic. 189 In three cases a large colon abnormality was identified but the colon ruptured during surgery. One 190 further horse was euthanased on the operating table with a diagnosis of septic peritonitis. The 191 remaining three horses survived surgery but were subsequently euthanased due to post-operative 192 colic or ileus. Due to the small numbers of horses that died or were euthanased, further statistical

193 analyses were not conducted.

194 **DISCUSSION**

195 The results of this retrospective cohort study have defined the signalment, incidence and mortality 196 rate of colic within the British military working horse population.

197

198 The incidence of colic in this study population was 11.1 episodes per 100 horse years. Published 199 incidence rates of the general horse population in temperate climates vary from 3.5-26.0 cases per 200 100 horse years.^{2-3,6-8,14} This population is therefore within the mid-range of previously established figures. Hillyer et al^2 recognised that the true incidence of colic is likely to be underestimated by 201 202 practice-based surveys. The current figure is therefore likely to be closer to a true incidence than 203 other studies because every episode of colic in this population is reported to the veterinary team and 204 recorded in the clinical record, regardless of the severity of the colic episode or the treatment 205 undertaken.

206

Only two previous studies estimate the overall mortality rate of colic in the general population: 207 208 Kaneene et al¹⁷ found that 0.6% (10/1818; 95%CI 0.3-1.0) of horses died from colic, while Higuchi's¹⁸ 209 study reported an estimate of 2.0% (306/15,208; 95%CI 1.8-2.2). In this study population the result was 1.8% with a 95% confidence interval of 1.0-3.1%. Published estimates of the mortality rate 210 amongst horses suffering from colic^{2-3,6-7,17,19} (excluding studies examining referral equine 211 populations) range from 6.3% (32/509; 95%CI 4.3-8.8)² to 13.0% (10/77; 95%CI 6.4–22.6),³ which 212 213 is again comparable with our estimate of 8.0% (95%CI 4.3-13.2). Finally, in our study the incidence 214 of mortality was 0.5 cases per 100 horse years, which is comparable with published values of between 0.24 and 0.7 cases per 100 horse years.^{1-3,6} We therefore concluded that the occurrence 215 216 of colic-related deaths in British military working horse population does not differ significantly from 217 that of the general population.

218

In our study, sex was not associated with the likelihood of suffering a colic episode. There is a single study in which geldings were found to have a reduced risk of colic³ and another that found geldings have an increased risk of colic,²⁰ but the current findings fit with the majority of studies which state that the risk of colic does not vary by sex.^{1,4-7,9,12,19,21-22}

Given that the majority of horses had no specific breed listed in their documentation, the country of purchase was investigated as an alternative parameter which may give some indication of breedassociated relationships. Horses purchased from mainland Europe had a higher rate of colic than those from Ireland or GB. Most of the military working horses that originate from mainland Europe may be classified as warm blood types as opposed to the Irish and GB horses which would generally be classed as cold blood types. These results are therefore in accordance with previous studies identifying higher rates of colic in Warmbloods and Thoroughbreds than in cold blood breeds.^{1,11}

231

Although all British military working horses are managed in a highly structured manner, there are some substantial differences between the three populations, depending on their role. For instance, the horses at the DAC are more likely to undertake schooling work and are all stabled whereas the HCMR horses primarily undertake road work and are mainly stalled. The lower occurrence of colic in the DAC than in HCMR horses observed in this study may be explained by DAC horses having more ready access to pasture¹¹ and more regulated care-giving^{2,5} compared with the HCMR horses.

239 Previously reported median/mean ages of horses experiencing colic episodes range from 4.8 to 10.3 years.^{1,3-5,12,20-21} Some studies report an increased risk of colic with increasing age^{1,5,18} whilst others 240 report no association.^{19,21} The median age of 9.8 years in our study population was therefore at the 241 242 higher end of the range of other studies. British military working horses are typically selected for 243 purchase at around five years of age and consequently there were only a small number of younger 244 horses in the current study population. We also found that the median age of horses dying from colic 245 (12.5 years) was greater than for horses experiencing colic in general; it is also often stated that the 246 risk of colic-related mortality increases with age.^{1,3,5,18}

247

There are variable reports of the seasonality of colic although most reports find an increase in the spring.^{2,6-7,18-19} The highest number of colic episodes during this study were in November and June/July. These months coincide with the tail-end of the busiest periods of ceremonial activities, with multiple parade rehearsals and disruption to the horses' daily routine in the weeks running up

to these times, followed by a complete change in routine as the horses are moved to grass turnout for a number of weeks over the summer or winter. Conversely, December and January are a quiet time in the ceremonial calendar for the horses; their regimen is more strictly adhered to and more horses are at pasture thereby resulting in fewer colic episodes at this time of year. Although we did not analyse the occurrence of colic across years, Egenvall *et al*¹ found no pattern of colic incidence across the six years of their study.

258

259 Only 3% of the study population were referred for surgery at an equine referral hospital which is comparable to published estimates ranging from 1.4 to 17.0%.^{2-3,7} Reported estimates of mortality²⁻ 260 261 ^{3,5,20-22} of horses undergoing colic surgery range from 30.8% (4/13; 95%CI 9.1-61.4)³ to 58.0% 262 (195/336; 95%CI 52.6-63.4)²² with a grave prognosis (between 97.3²² and 100%⁵ mortality) for 263 horses whose viscera rupture during surgical manipulation. The surgery mortality rate in our study 264 population was high (87.5%; 95%CI 47.3-99.7), probably because the management of colic cases 265 within barracks went beyond what would be expected of a normal primary care veterinary surgeon 266 and horses were only referred for surgery when their condition deteriorated, by which time the overall 267 prognosis for survival had already reduced. However, because of the very small numbers of horses 268 that underwent surgery in our study population the confidence intervals are very wide, and they do 269 overlap with published estimates of surgical mortality rates.

270

271 Multiple studies briefly document the number of horses experiencing more than one colic episode during their study period,^{2,3,6,13,19} however few studies specifically examine recurrent colic.²³⁻²⁵ The 272 273 definition of recurrent colic differs between these studies; most recently Scantlebury et al (2011) 274 defined it as a subsequent episode of colic that occurred "on the proviso that the horse had been 275 free from colic signs, eating a normal diet and passing normal faeces for a full 48 hours since the 276 end of the previous colic episode". Due to the variety of detail contained within the clinical records 277 of this population, it was not always explicitly stated that an episode of colic had resolved. We 278 therefore defined an episode of colic as being recurrent if at least 48 hours passed between colic 279 episodes, during which time the clinical record recorded no further abnormalities that may be 280 associated with colic and we took this to mean that the horse had returned to normal feeding and

281 faecal output. Based on this assumption, we found that 35% of horses (95%Cl 27.7-42.8) suffering from colic experienced recurrent colic episodes and that the incidence of recurrent colic was 65.7 282 recurrent episodes per 100 horse years. Reported estimates of recurrent colic vary from 3.9% (7/179; 283 95%CI 1.6-7.9)¹⁹ to 53.4% (102/191; 95%CI 46.1-60.6)¹³ with the most recent study²⁴ documenting 284 an estimate of 36.5% (38/104; 95%CI 27.3-46.5) and an incidence of 50 episodes per 100 horse 285 years which is broadly similar to our findings. Scantlebury et al's study²⁴ also recorded a recurrent 286 287 colic mortality rate of 10.5% (4/38; 95%CI 2.9-24.8) and an incidence of death from recurrent colic 288 of 3.37 deaths per 100 horse years. These findings are also similar to our own which were 12.3% 289 (95%CI 5.1-23.7) and 4.4 deaths per 100 horse years respectively.

290

We found that female horses were more likely to suffer from recurrent colic than male horses; this is in contrast to Scantlebury's study²⁵ which found no relationship with sex. Signs of colic are not always linked to gastrointestinal pain and female horses may experience colic episodes attributable to reproductive tract pain, either in relation to seasonal behaviour or reproductive tract abnormalities.

295

As we found with all colic episodes, horses from Europe were more likely to suffer from recurrent colic than horses purchased from Ireland. A previous report found no association with breed²⁵ however this may again be explained by the country of purchase relating to breed type, as previously discussed.

300

The median age of horses suffering from recurrent colic episodes in our population was 8.8 years which is slightly younger than previously reported (11 years)²⁴ however no association of age with occurrence of recurrent colic has been documented.²⁵ The median age of horses dying from recurrent colic in this study was 14.2 years however there are no previously recorded findings to compare this figure to.

306

The highest number of recurrent colic episodes occurred in November, which was also the peak time for all colic episodes. The least recurrent colic episodes occurred in January and June; January was also a quiet time for colic in the whole population however June and July were the second busiest

months for colic. Season is not discussed in any of the publications regarding recurrent colic²³⁻²⁵ so it is difficult to draw any worthwhile conclusions. The highest number of recurrent colic episodes occurred in 2011 and 2012 which is also similar to the occurrences of all colic episodes, however there was a much lower number of recurrent colic episodes in 2008, in contrast to the number of colic episodes overall. This may represent either an increase in the number of horses experiencing recurrent colic or increased identification of subtle colic signs in horses that were prone to recurrent colic episodes.

317

Four (3.8%) episodes of recurrent colic were treated surgically in comparison to Scantlebury *et al*'s study²⁴ in which 12.5% underwent surgery. Our estimate may represent more horses experiencing low grade, mild colic that did not require surgical treatment. Cases of colic may also have been recognised sooner, especially in horses that were known to be prone to colic, enabling prompt effective treatment before the case required surgical intervention.

323

In any study describing a disease process, the results obtained are dependent on the specific study design and population. This is accentuated when considering equine colic studies where data may be gathered from owners, primary care vets, referral hospitals or insurance statistics, and the study population ranges across many different countries and specific horse groups. Although this study has detailed yet another cohort of horses, the intensive nature of their day-to-day management is not dissimilar to other strict horse management regimens (e.g. police horses, racehorses) therefore these results may be applicable to such populations.

331

Despite their intensive management, British military working horses do not seem to experience a higher rate of colic or colic-related death than the general equine population. We did not attempt to establish specific risk factors in this population due to the variety of detail recorded in the clinical records and due to non-availability of details regarding factors such as daily exercise, pasture turnout and stereotypical behaviours. However, some previously identified risk factors are pertinent in this population, for example stalling and reduced access to pasture,¹¹ exercising more than once per week¹⁰ and having more than one care-giver.^{2,12} Equally, some features of the management of these

339 horses are likely to contribute to a reduced colic rate, for instance regular anthelmintic treatment and 340 careful dietary changes.¹⁰⁻¹¹ Risk factors for recurrent colic include stereotypical behaviours (cribbiting,²⁴⁻²⁵ windsucking²⁴⁻²⁵ and weaving²⁵) as well as known dental abnormalities,²⁴ and increased 341 time at pasture is associated with a reduced risk.²⁵ It is not possible to comment on the association 342 of stereotypical behaviour on the risk of recurrent colic in this population as the clinical records do 343 344 not note such behaviours. Further studies would be required to identify and quantify the risk factors 345 within this unique population including, but not limited to: dietary management, stereotypical 346 behaviours, access to pasture and daily exercise regimen/ceremonial parade schedule.

347

The biggest limitation of this study was the retrospective analysis of data. Further description of each colic episode to determine investigatory procedures, diagnosis, treatment given, and potential risk factors was not possible due to a lack of specific clinical notes relating to these parameters in many cases. The limited nature of this population is also recognised with only small numbers of young (<5 years old) and geriatric (>20 years old) horses, and of entire male horses.

353

This retrospective cohort study concludes that, despite their intensive management regimen, the occurrence of both colic and colic-related deaths within the British military working horse population are similar to those of the general horse population.

357 COMPETING INTERESTS

- 358 V.J. Tannahill is a serving Reserve Veterinary Officer in the Royal Army Veterinary Corps. J.M.
- 359 Cardwell and T.H. Witte have no competing interests to declare.

360

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366

367 AUTHORSHIP

V.J. Tannahill contributed to all aspects of the study. J.M. Cardwell contributed to analysis and
 interpretation of data, manuscript preparation, and final approval. T.H. Witte contributed to study
 design, manuscript preparation and final approval.

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430 FIGURE LEGENDS











Figure 3 – Number of recurrent colic episodes per month and per year.