TITLE: Mortality due to trauma in cats attending veterinary practices in central and south-east England

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Mortality due to trauma and road traffic accidents in cats attending UK veterinary practices

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Abstract

Background: Trauma is a frequently attributed cause of mortality in domestic cats, with a considerable component due to road traffic accidents (RTA). A comprehensive understanding of feline mortality due to trauma, and the subset due to RTA, requires evaluation of major demographic and spatial risk factors.

Objectives: To identify important demographic and spatial factors associated with the risk of trauma and also more specifically RTA related mortality relative to other diagnoses in cats

Methods: A sample of 2,738 cats with mortality data derived from the VetCompass primary-care veterinary database was selected for detailed study. Generalised linear models investigated risk factors for mortality due to trauma and due to RTA versus other causes.

Results: Age was strongly associated with traumatic and RTA attributed mortality, with a greater proportion of younger cats dying from trauma and RTA relative to other causes of mortality ($P<0.001$). No association with urban environments or areas where there is increased human population density was identified for mortality due to trauma or RTA.

Clinical significance: These findings highlight that veterinary advice which aims to reduce the likelihood of mortality due to trauma, and specifically RTA, should focus on demographic attributes including age and that all geographical locations should be considered as of equal risk.

Keywords: Feline, Epidemiology, RTA, VetCompass

Introduction

Traumatic events, defined as tissue damage caused by an unexpected external force (Menon *et al.* 2010), are a significant cause of injury and death in domestic cats in the UK (O'Neill *et al.* 2014, O'Neill *et al.* 2015, Wilson *et al.,* 2017) and worldwide (Egenvall *et al.*2010). Trauma was the most common cause of mortality (12.2% (O'Neill *et al.* 2015)) in cats attending veterinary clinics in England, and accounted for almost half of all mortality cases in cats younger than three years (O'Neill *et al.* 2015). Trauma was also the most common cause of insurance claims for cats in Sweden (Egenvall *et al.* 2010). Traumatic injury is often associated with outdoor access, most commonly due to vehicular trauma, but also other risk factors such as falls and dog attacks (Egenvall *et al.* 2009, Egenvall *et al.* 2010, Olsen and Allen, 2001). Road traffic accidents (RTA) are reported to account for 60-87% (Egenvall *et al.* 2009, O'Neill *et al.*2015, Olsen and Allen 2001) of all traumatic injuries in cats. Analysis of clinical data from six veterinary practices near Cambridge in the UK showed that RTA were the fourth most common cause of cat deaths (Rochlitz 2003a) and that common risk behaviours for RTA was crossing roads (Loyd *et al.* 2013) and hunting at the roadside (Wilson *et al.,* 2017). However, despite trauma being largely a consequence of cats interacting with and exploring their environments (Egenvall *et al.* 2010), spatial factors that may predispose cats to increased risk of mortality have been poorly explored and warrant investigation.

To date, a number of potential demographic risk factors for trauma in cats have been reported, with increased risk in younger cats (O'Neill *et al.* 2015, Rochlitz 2003b), crossbred cats (Rochlitz 2003a) and males (Rochlitz 2003a). Although, it has been suggested that living in areas of high human population density (Childs and Ross 1986) and higher levels of traffic (Rochlitz 2003b) may increase the risk of RTA and subsequent mortality, there have been few geographic studies that provide evidence to support these putative risks. Indeed, results from a study of cats under one year found the opposite to be true, with increased risk of

RTAs in rural areas (Wilson *et al.,* 2017). The estimated 17% of UK households that own a pet cat (Pet Food Manufacturers' Association 2016) are spread across the rural-urban spectrum (Murray *et al.* 2010) of different population densities and such spatial attributes may affect exposure to geographic risk factors for trauma. Approximately 76-91% of cats in the UK have outdoor access (Murray and Gruffydd-Jones 2012, PDSA 2015), which increases the risk of cats for RTA, fighting and other accidental trauma-related events. Although indoor confinement will prevent RTAs (Moreau *et al.* 2003; Toribio *et al.* 2009), and reduce risk of trauma (Olsen and Allen, 2001), there is debate about the implications of confinement on other aspects of cat welfare (Buffington, 2002). Therefore, an improved evidence-base on demographic and geographic risk factors for trauma-related mortality can at least help welfare and veterinary bodies to formulate advice regarding outdoor access based on quantitative rather than qualitative risk values and will be able to provide owners with more precise information on the relative risks of indoor versus outdoor lifestyles for their cats. Owners can then make better informed risk assessments when deciding about outdoor access options for their cat.

Using veterinary clinical and location data extracted from the VetCompass Programme database, this study aimed to evaluate associations between geographic risk factors, alongside cat demographic characteristics, and the relative likelihood of mortality due to trauma and RTA, relative to other causes of mortality. RTA is of particular interest due to its inextricable links to cats that are outside, therefore, we deem it appropriate to consider both the wider category of trauma and the specific RTA subset in this study. We use two potential proxies for geographic risk factors; human population density and rural-urban classification. Both account for human population size, with the latter also considering characteristic urban features. It was hypothesised that mortality cases in cats living in areas with high human population density and in urban areas, where road traffic is likely to be higher, have a higher incidence of RTA-related mortality compared to their rural counterparts. Additionally, we explore whether further inferences can be made by analysing the incidence of all trauma-related mortality cases, which encompasses a diverse assortment of deaths, in light of geographic location.

Materials and Methods

This study was a further analysis of the clinical dataset that supported a previously reported study on overall mortality in cats (O'Neill *et al.* 2015). In summary, the study population was identified from the VetCompass Programme of companion animal surveillance (www.rvc.ac.uk/vetcompass) which shares de-identified electronic patient record (EPR) data from UK primary-care veterinary practices, located in central and south-east England. This study used EPR data that were uploaded to VetCompass between 1 September 2009 and 20 December 2012. Ethical approval for the study was granted by the RVC Ethics and Welfare Committee (reference number **2015/1369**).

As previously described (O'Neill *et al.* 2015), practice selection was a convenience sample of practices with a willingness to participate and the use of an appropriately configured practice management system (PMS). Study time constraints precluded inclusion of all deaths into the study. We consequently applied the same dataset used in a previous study (O’Neill *et al*. 2015), where cases were determined randomly using an online random number generator (www.random.org). This included 4009 cats with confirmed deaths attending 87 practices that were randomly selected from all deaths available in the overall VetCompass database. Detailed manual review of the clinical notes for each confirmed death was used to extract the cause of mortality and link this to a VeNom diagnosis term (The Venom Coding Group). If a cause of mortality was not explicitly stated in the clinical records, then an entry was included to show that no cause of mortality was recorded. For all deaths, clinical information on diagnoses were used to assign individual cats to two groupings, those that died due to trauma, defined as animals that had undergone a physically traumatic event, and those that died from everything else (non-traumatic causes e.g. renal disorder, neurological disorder, neoplasm and mass lesion finding). Using the same approach, cats were also categorised as to have died from RTA related injuries, a subcategory of trauma, or died from non-RTA related causes. All diagnoses used in the study relied on the final recorded opinion of the veterinary practice. This opinion was based on clinical conclusion from multiple evidence sources including prior knowledge of the cat, the history elicited from the owner, the clinical exanimation of the cat both at the time of initial presentation and any further visits and further testing results including radiography. In addition, the final recorded opinion may often have been based on the summative knowledge from multiple members of the veterinary team over a protracted period of time.

Data linking human population densities (people per hectare) and rural-urban classification with partial postcodes in England were obtained from the Office of National Statistics (ONS; http://www.ons.gov.uk) for 2011, which lies within the time period clinical data were obtained and is the most recent year of data available. Specifically, population densities were available from the ONS for different postcode sectors; these correspond with the VetCompass format of partial postcodes (e.g. for 'AL9 7TA', postcode sector is 'AL9 7'). Through cross-checking the partial postcode data field within the VetCompass database with data from ONS, population density estimates were provided for each mortality case. Rural-Urban classifications were available from the ONS for output areas. Output areas are the lowest geographic level at which census estimates are provided and each contains a minimum of 40 households, with a target size of 125 households per area. Rural-urban classifications were assigned to the partial postcodes in VetCompass by cross-referencing output areas to 2011 postcode sectors data from the ONS. Additionally, latitude and longitude were obtained for each VetCompass partial postcode using data from the ONS to enable visual mapping and further spatial analysis described below.

Before analysis, data were imported into Microsoft Excel 2010 and incomplete records were removed in accordance with the following criteria. Mortality cases were not taken forward for analysis if the cause of mortality or a recognisable partial postcode in accordance with postcode sector data was not recorded.

In addition to spatial risk factors (population density and rural-urban classification), the demographic covariates used in this study included age at death, purebred status, sex, neuter status (neutered/not neutered), bodyweight, colour and insurance status. Cats with recognised standard breed names were grouped as ‘purebred’, while cats described as mixed-breed, breed-specified crosses or domestic cats were grouped as ‘crossbred’. Although the colour data covered a wide range of variants, the current study summarised these data to simply distinguish between cats that had black recorded as their total or dominant colour and all other colour variants to provide a binary variable of black and not black. The age at death relied on the date of birth values recorded in the veterinary practice management system. The neuter status recorded on the date of death was used. Note, as the age conventionally recommended for neutering in cats is approximately 6 months (Murray *et al.* 2009, Olson *et al.* 2000), we excluded cats younger than 6 months when testing neutered status. This reduced confounding between neutered status and age effects. Similarly, we only included cats 6 months or older when testing the effect of bodyweight defined as the maximum bodyweight recorded after 6 months of age. We also included the insurance information for each cat as a binary variable; insured and not insured.

Statistical analyses were performed using R version 3.2.3 (R Core Development Team 2015). The variation in cause of death was analysed using generalized linear models (GLMs) with a binomial error structure, which accounts for non-normal residual error structures, to investigate death due to trauma (model 1) or RTA (model 2), compared to death from other causes with feline demographic and human community attributes as predictor variables.

The spatial distribution of mortality cases was mapped using the package ggmap (Kahle and Wickham 2013) in R. To determine whether trauma mortality cases overlapped geographically with non-traumatic cases, 95% spatial kernels were estimated using the R package adehabitatHR (Calenge 2006) to compare the spatial distribution between trauma and non-traumatic related cases. The extent of overlap of spatial kernels was estimated using Bhattacharyya's affinity (BA (Bhattachayya 1943)) which ranges from 0 (no overlap) to 1 (complete overlap). This analysis was repeated to compare the spatial distribution of RTA mortality cases with mortality not due RTA. See supplementary information for full details of the statistical analyses.

Results

The demographic and spatial analysis for the current study included 2738 cats from the 4009 (68.3%) confirmed deaths of cats attending 87 practices that were reported in the original longevity study (O'Neill *et al.* 2015). Of the 1271 excluded deaths, postcode data were incomplete or missing from 843 records (21.0%), the recorded postcodes were not identifiable through cross matching with the ONS data for 57 (1.4%) and a further 371 (9.3%) did not have the cause of death recorded.

The human population density across partial postcodes sectors ranged from 0.3 to 23.4 people per hectare (Table 1). Across the households of deceased cats, 2204 (81.3%) resided within an urban area.

The median age at death overall was 14 years (range 0 – 25; Fig. 1). Demographic characterisation of the overall deceased cats (with available information recorded) indicated that 2520 (92.2%) were crossbred, 1385 (50.9%) were female, 2272 (83.0%) were neutered and 2251 (82.2%) were not insured.

Death due to trauma was assigned to 210 (7.7%) of the 2738 deaths, within which 119 (56.7%) were recorded as RTA. We note that true prevalence of mortality due to trauma is in fact higher (12.2%; O'Neill *et al.* 2015), however a disproportionate amount of trauma cases were removed due to lack of postcode data. For cats that died from trauma, the median age at death was 3 years (range 0.1 – 22; Fig. 1) and for cats that died from the RTA subcategory median age at death was 2.7 years (range 0.4 -21). Demographic characterisation of cats that died from trauma and those that died from the nested RTA subcategory were largely similar (Table 1).

Euthanasia accounted for 2482 (90.6%) deaths overall, with a greater proportion of cats that died from non-trauma related diseases (2356, 93.2%) being euthanised compared with those that died from trauma (126, 60%; $p<0.001$) or RTA (59, 49.6%; $p<0.001$). Cats were more likely to be euthanised at lower population densities ($p=0.008$). Cats were more likely to be insured at higher population densities ($p<-0.001$).

Trauma-related mortality

Trauma-related injuries accounted for 7.7% of deaths in this analysis, these included, but are not limited to, RTA, falls, animal attacks and getting trapped in various locations. Looking at potential spatial factors that are associated with mortally due to trauma in cats, no statistical difference was detected between cats in rural and urban areas in their proportion of mortality due to trauma (Table 1). Additionally, human population density was not associated with the proportion of mortality due to trauma (Table 1). There was a high level of geographic overlap between trauma and non-trauma cases (BA = 0.876), the spatial distributions were not significantly different (p = 0.21; Fig. 2).

Focussing on individual cat characteristics in cats older than 6 months (n=2651), neither neutered status nor bodyweight were significantly associated with the proportion of mortality due to trauma (Table 1). We note that 14.6% (n=388) of deceased cats older than 6 months were not neutered. Additionally, changing the age-threshold to 16 weeks, the BVA's recommended neutering age, did not change the findings. The remaining variables were not age-dependent and thus were tested on the full dataset of cats. The proportion of mortality due to trauma was not significantly different between male and female cats or between insured and uninsured cats (Table 1). Predominately black cats were not significantly more likely to die from trauma than other colour variants (Table 1). A significantly lower proportion of mortality was due to trauma in purebred cats compared to crossbred cats (χ_1^2 = 9.30, p = 0.002; Table 1, Fig. 3). The proportion of mortality due trauma reduced as the age of death increased (χ_1^2 = 324.31, p < 0.001; Fig. 3).

RTA-related mortality

We explored the risk of mortality due to RTA (a subset of the total trauma cases). Similarly, we found no association between human population density or human settlement type (urban/rural) and the proportion of mortality due to RTA in cats.

All cat demographic characteristics were insignificant with the exception of age (Table 1). Increasing age at death was significantly associated with decreasing proportional mortality due to RTA (χ_1^2 = 228.09, p<0.001; Table 1).

Discussion

This study has explored a range of geographic and feline demographic risk factors for associations with mortality in cats from trauma and RTA. Whilst outdoor access has previously been associated with increased risk of trauma in cats (Egenvall *et al.* 2010), access to a geographically-large dataset means that the current study could examine whether variation in mortality due to RTA and trauma versus other causes of death were associated with different landscapes (urban/rural) and a range of human population densities. Using mortality data on over 2700 deceased cats that attended primary-care veterinary practices in England, we find no evidence supporting higher mortality due to trauma or RTA with increased human population density or at different degrees of urbanisation of an area. Additionally, we have illustrated how age can affect mortality risk from trauma and RTA.

Previous studies have reported that lower bodyweight is associated with increased longevity overall (O'Neill *et al.* 2015). However, the current study found no association between bodyweight and risk of death specifically from RTA or trauma, suggesting that any increased risk mortality with increased bodyweight in the overall cat population is not driven by an increased risk of trauma-related mortality in heavier cats.

The current study identified no support for the common belief that black cats are more likely to die from RTA than non-black cats (SPCA 2016). This lack of association is in accordance with results from previous studies that also found black cats were not statistically more likely to be hit by a car (Rochlitz 2003a, Wilson *et al.,* 2017). If there truly is no increased risk of RTA for black cats, it is important for this message to be transmitted to the wider public who appear to be reluctant to rehome black cats, possibly because of fear of losing them to road deaths because they have an unlucky colour (Cats Protection 2016). However, further research is necessary as we can't discount the possibility that demographic attributes of cats that die from RTA are different to those who are injured but don't die from RTA.

Previous studies have suggested that male cats are at higher risk of trauma events compared with female cats (Egenvall *et al.* 2010, Rochlitz 2003a, Rochlitz 2004). However, the current study did not identify strong evidence for an association between sex and the risk of mortality due to trauma-related injuries, a result consistent with a study on cats less than 12 months old (Wilson *et al.* 2017). Although the descriptive statistics suggested that a lower proportion of females than males died from trauma compared with deaths from non-trauma disorders, this difference was not statistically significant when tested in the GLM framework which takes into account multiple variables.

The current study found no evidence that neuter status was associated with the risk of mortality due to RTA or trauma in cats aged older than six months. Studies of free-ranging cats suggest that entire cats have larger home ranges than those that are neutered (Hervías *et al.*2014, Kitts-Morgan *et al.* 2015). If this is also the case for owned cats, it would appear that the distance that cats roam is not related to their risk of trauma or RTA. However, little is known about the impact of neutering on the roaming habitats of owned cats and how (or if) home range size translates to mortality risk.

Age has previously been reported as an important determinant of risk of death from trauma and RTA in cats in the UK, with younger cats reportedly at higher risk of death from both events relative to other causes of mortality (O'Neill *et al.* 2015, Rochlitz 2003a). The current study similarly identified that younger cats were at higher risk of death from trauma and RTA. These age associations may reflect the degree to which individuals of varying age have outdoor access and differences in the activity levels in cats. Older cats are reported to engage less in risky outdoor behaviours such as road crossing or interactions with unfamiliar cats

(Loyd *et al.* 2013) with consequently reduced mortality risks from RTA (Rochlitz 2003a) or trauma (O'Neill *et al.* 2015).

The current study identified that purebred cats were at reduced risk of mortality due to trauma compared to crossbred cats, although no significant difference between purebred and crossbred cats was identified for mortality risk due to RTA. These findings may reflect differing management styles from owners in respect to these two groups of cats, such as outdoor access. Purebred cats have previously been found to be significantly more likely than crossbreds (Toribio *et al.* 2009, Turner 2000) to be housed indoors. However, we cannot discount behavioural differences as purebred cats have been selected as pet animals and therefore may be predisposed to certain behavioural traits such as reduced wandering or less risk-taking than crossbred cats. The failure of the current study to identify a purebred/crossbred association with RTA could be due to small sample count of purebred cats that died from RTA (n = 8) and consequently low statistical power to detect such differences.

With 12.2% of all cat deaths attributed to trauma (O'Neill *et al.* 2015), and many of these deaths in younger cats, prevention or reduction in trauma-related mortality could substantially enhance overall cat lifespans. As the majority of trauma-related mortality events occur in younger cats, the impact of trauma prevention on overall lifespan would be more profound compared to reducing diseases such as renal disease or neoplasia that mainly impact on older cats (O'Neill *et al.* 2015). There is strong evidence that outdoor access is associated with increased risk of trauma and road traffic accidents (Moreau *et al.* 2003; Olsen and Allen, 2001). Therefore, indoor restriction could potentially reduce risk of trauma, and could eliminate risk of RTA, assuming there is no chance of escape. However, it is worth noting that although house-confinement may increase longevity, there is currently no consensus that an indoor lifestyle would improve overall cat welfare (Rochlitz 2005). The reduced physical activity that is contingent upon an indoor lifestyle may increase the risk of other disorders such as obesity (Robertson 1999) and feline lower urinary tract disease (Sævik et al. 2011), and could lead to increased behavioural problems (Amat et al. 2009). With the majority of the UK cat population allowed outdoor access (Murray and Gruffydd-Jones 2012, PDSA 2015), further research to better understand the relative general welfare of indoor and indoor/outdoor pet cats is needed.

Although urban areas with high population densities could logically be considered more hazardous for wandering domestic cats, the current study did not identify differing risks of mortality due to trauma or RTA between cats residing across a variety of community types in England. If cats' cross roads at random, then we might expect road fatalities and trauma to be higher in areas with higher population density and more traffic. We suggest three non-exclusive explanations that may contribute to the lack of differing real-world trauma and RTA mortality risk between differing geographical areas.

First, cat behaviour may differ in high risk areas. Cats in highly populated areas with increased traffic flows may be discouraged from attempting to cross major roads and therefore reduce their movement, but equally have increased probability of death per attempted road crossing. A similar effect has been reported to occur in wild badger populations (Clarke *et al.* 1998). Additionally, urban cats may have smaller home ranges than their rural counterparts. Although ranging behaviour of the cats in the current study was unknown, increased ranging of rural cats compared to urban cats has been reported in previous studies (Lilith *et al.* 2008, Metsers *et al.* 2010). Both these behavioural differences may mitigate and reduce the risk of mortality to urban cats to a level comparable to their rural counterparts.

Second, the lack of observable risk difference between rural and urban cats may be due to differing husbandry of cats between these areas. There is a general perception amongst cat owners that cats are at an increased risk of trauma and road accidents in urban areas (Murray *et al.* 2010). Although, the current study did not collect information on the indoor vs. outdoor time budgets, we cannot discount the possibility that a higher proportion of cats are kept indoors in urban compared with rural areas.

Third, reporting differences due to variability in the return of cats, either alive or dead, to their owners and access to veterinary care may vary between geographic areas. Our results suggest that cats are more likely to be euthanised in areas of low population density. Whilst this result may be due to financial difference between areas, an additional non-exclusive explanation is that cat owners may be less likely to report their deceased cats to veterinarians in less built up areas. As natural mortality is higher in cats that have died from trauma relative to other mortality cases, fewer cases of trauma may be reported in these areas. Additionally, we find cats are more likely to be insured in high density areas, consequently we cannot discount the possibility that cats are more likely to be successfully treated in these regions. Future studies soliciting information on cat behaviour, husbandry and mortality events from owners (e.g. Wilson *et al*., 2017), in conjunction with those reported by veterinarians, will help to explore these potential explanations.

With no significant spatial determinant, the risk of trauma-related deaths (including RTAs) appears to be ubiquitous across different geographic areas, and instead is determined more by intrinsic demographic attributes of the cat. Therefore, there is no evidence from the current study for differing general management recommendations or advice aimed at reducing risk of trauma and RTA across community types. The inability to identify a geographic association with mortality risk of trauma and RTA could be due to the small sample size of cats, for example only twenty cats died from RTA in a rural community. Additionally, we used ONS data as proxies for increased traffic and other attributes such as increased pet ownership and building infrastructure, which may increase risk of animal attacks and falls, respectively. To tease apart these respective risks more detailed geographic data may be required such as knowledge of the traffic on roads or road classification (Wilson *et al.,* 2017) within roaming distance of the cat's residence. Future VetCompass studies exploring differing cat behaviour and husbandry across a wider range of geographic areas could further tease apart the underlying factors that may be contributing to trauma related mortality in cats and help to develop improved management strategies to reduce this important and potentially preventable category of feline mortality. Further studies focussing on the risk of RTA and traumatic injury would also complement our mortality-focussed analysis.

This study is limited geographically to central and south-east England and therefore the findings may not be completely generalisable to all veterinary practices, community types, cat mortality cases and owners across the remainder of the UK.

In conclusion, this large study of mortality of cats attending primary-care practices in England identified no association between risk of mortality due to trauma (or RTA) and the surrounding landscape. The proportion of mortality due to trauma and RTA decreased in older cats, and a higher proportion of crossbred cats died from trauma compared to purebred. Therefore, any management prioritisation to reduce impact of trauma should focus on these demographic attributes that are higher risk and all locations should be equally targeted.

Conflict of interest: No conflicts of interest have been declared

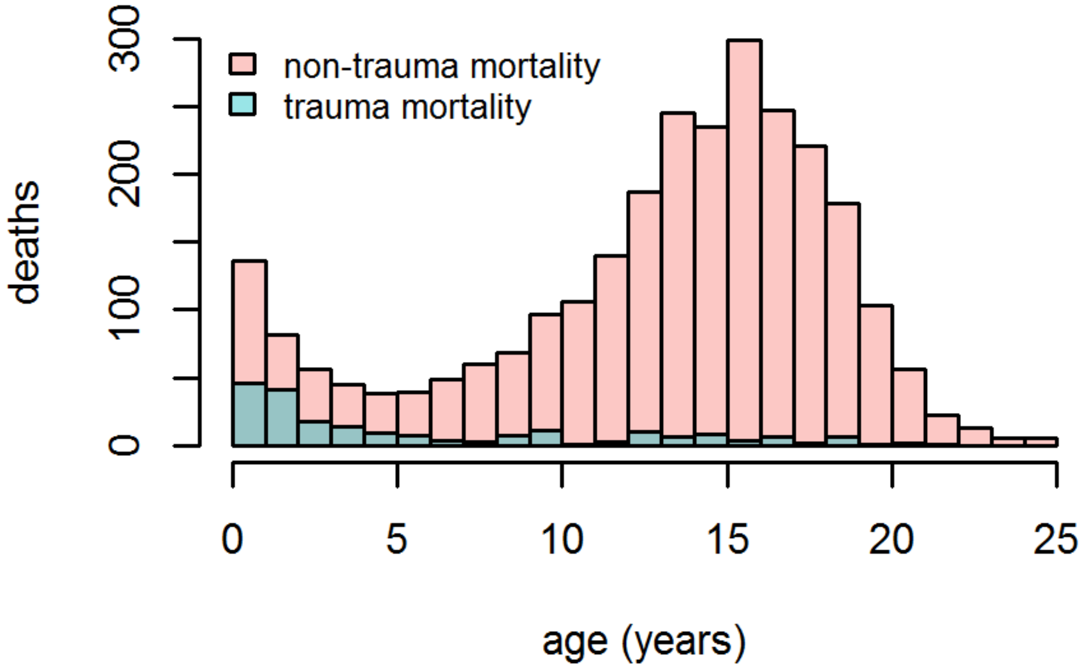
non-trauma mortality
trauma mortality
deaths
0
100
200
300
0
5
10
15
20
25
age (years)

Figure 1

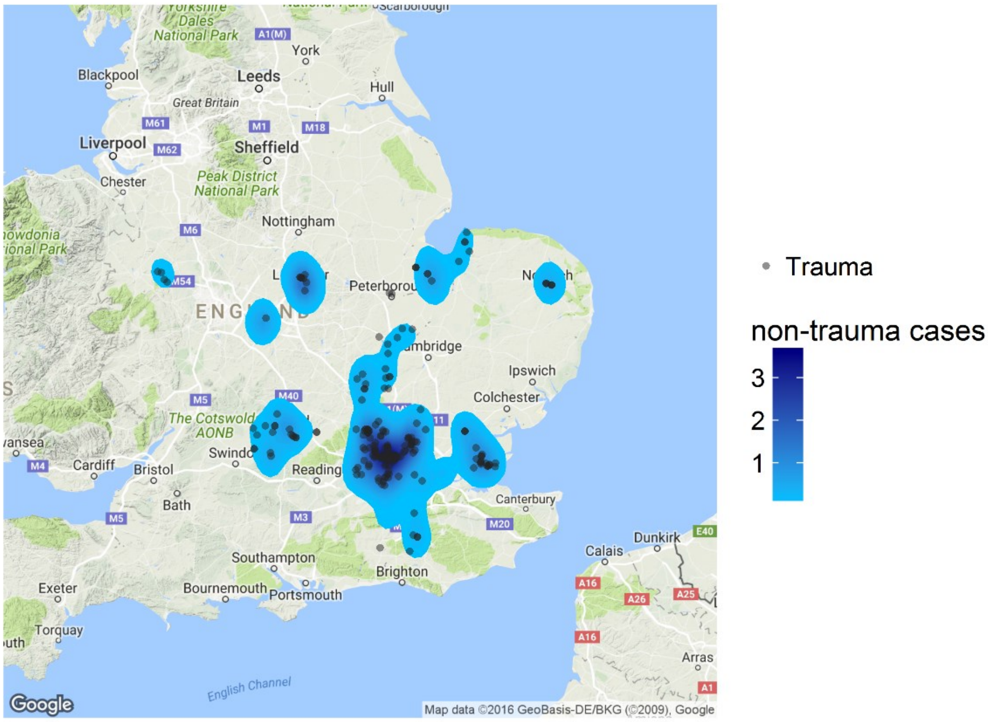
Trauma
non-trauma cases
3
2
1
York
Leeds
Blackpool
Hull
Great Britain
Liverpool
Sheffield
Chester
Peak District
National Park
Nottingham
ENGLAND
Ipswich
Colchester
The Cotswolds
AONB
Cardiff
Bristol
Reading
Bath
Canterbury
Dunkirk
Calais
Southampton
Brighton
Exeter
Bournemouth
Portsmouth
Torquay
Arras
English Channel
Google
Map data ©2016 GeoBasis-DE/BKG (©2009), Google

Figure 2

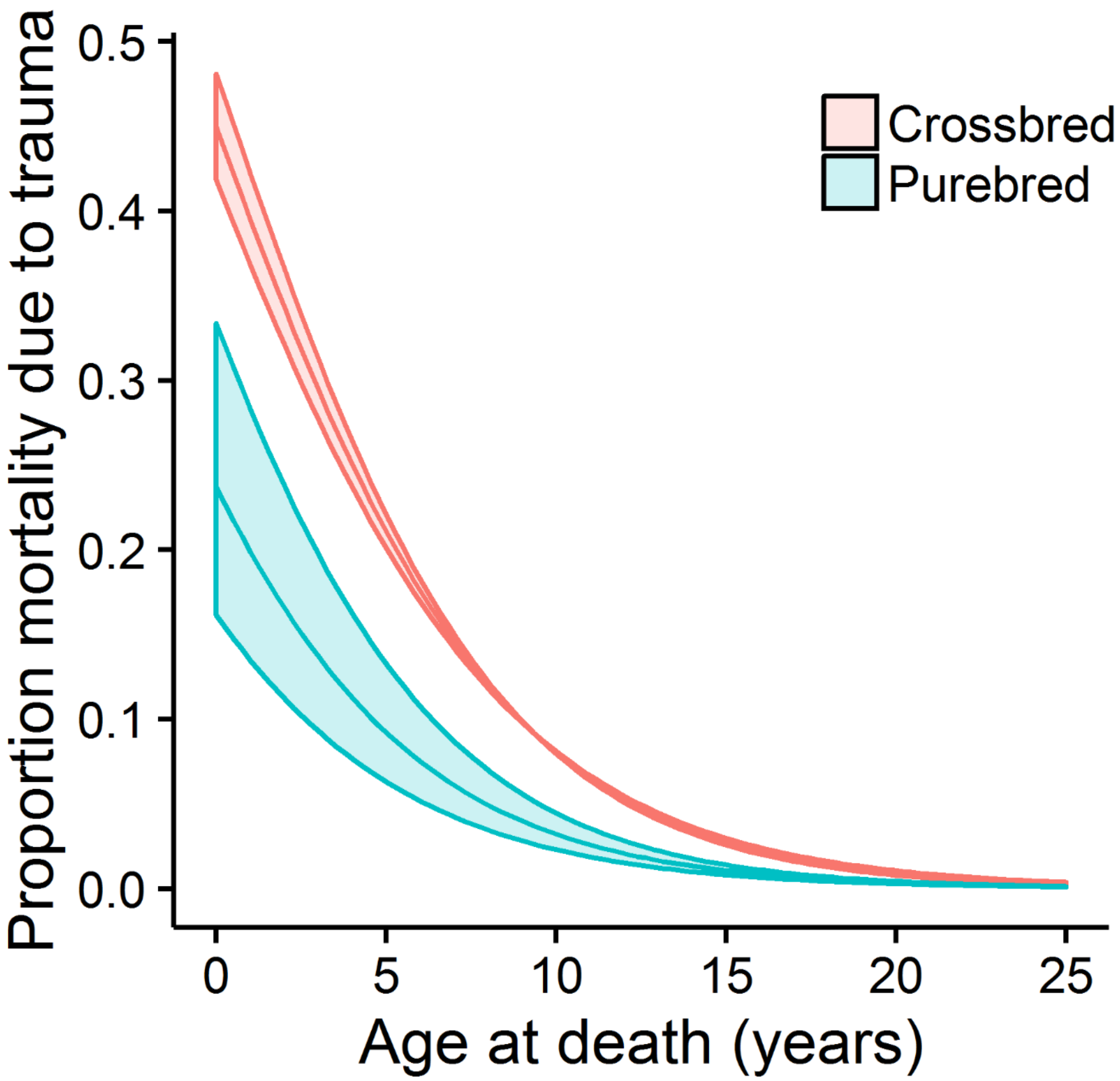
Crossbred
Purebred
Proportion mortality due to trauma
0.0
0.1
0.2
0.3
0.4
0.5
0
5
10
15
20
25
Age at death (years)

Figure 3

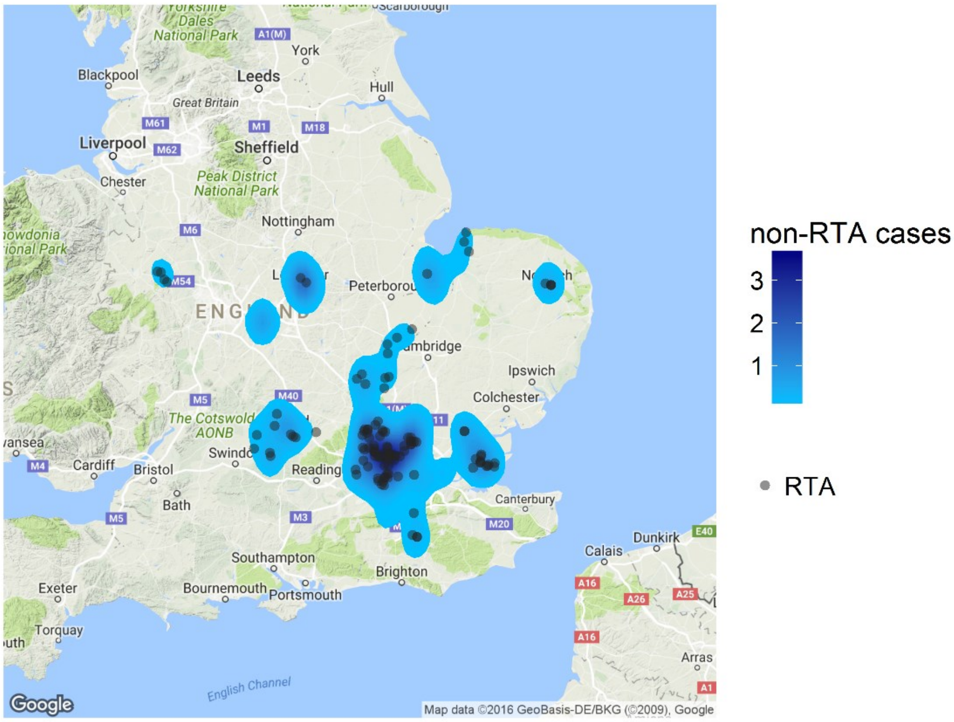
York
Leeds
Hull
Blackpool
Great Britain
Liverpool
Sheffield
Chester
Peak District
National Park
Nottingham
Ipswich
Colchester
Bristol
Cardiff
Bath
Reading
Canterbury
Southampton
Brighton
Bournemouth
Portsmouth
Exeter
Torquay
Dunkirk
Calais
Arras
English Channel
A1(M)
M61
M62
M1
M18
M6
M54
M5
M40
M4
M3
M20
A16
A26
A25
E40
A1
Google
Map data ©2016 GeoBasis-DE/BKG (©2009), Google
non-RTA cases
3
2
1
RTA

Figure 4

Figure 5

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Figure 1. Distribution of ages at death recorded in cats (n = 2732) attending VetCompass primary-care veterinary practices in England, showing the frequency of cats that died within 1 year age bands from trauma (blue) and non-trauma causes (pink).

Figure 2. Spatial distribution of mortality cases due to trauma compared with non-trauma deaths in cats attending VetCompass primary-care veterinary practices in England.

Figure 3. Age-related proportions of cat mortality (± standard error) attributed to trauma for purebred and crossbred cats attending VetCompass primary-care veterinary practices in England as predicted from a generalised linear model.