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A retrospective survey of injuries occurring in dogs and handlers participating in canicross

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Conflict of interest

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Summary

Objectives: Canicross is a popular canine and human cross-country sport. The purpose of this study was to identify the most common injuries, their severity, risk factors, and the recovery.

Methods: An internet-based retrospective survey design was used to examine the characteristics of injuries, demographic and competition information, and associations with injury rate.

Results: 160 surveys were received and indicated that at the time of the survey 21.9% of dogs (35/160) in this survey had experienced at least one injury. Lacerations, abrasions and punctures was the most common injury type (22/49), most frequently occurring in the footpads of the forelimb (13/16). The majority of dogs (38/49) recovered from their injuries. 69/147 of the human handlers experienced injuries while competing, being ankle injuries (25/69), and bruises, cuts, and grazes (20/69), the most common. Risk factors for injuries were being a purebred Labrador, dogs running with another dog, and additionally competing in agility.

Conclusions: Labradors, dogs running with another dog and dogs also participating in agility competitions were at higher risk for injury. Injuries of the footpads of the forelimb were the most common injuries in dogs. Most dogs had a complete recovery from their injuries.

Clinical Significance: This is the first study that gives us insight into injuries occurring in dogs and handlers competing in canicross. This will help making recommendations for this sport as well as enable veterinarians to understand the risks and injuries.

Introduction

Canicross is a sport in which human handlers run cross-country with dogs. It was originally popular as an off-season training for sled dogs but has now become a popular stand-alone sport. Dogs are typically attached to the human runner, the handler, by a shock absorbing lead such as a bungee cord or an elastic line, which is connected to a pulling harness on the dog and a waist belt on the human. The distance of canicross races ranges anywhere from 1 km to 45 km or more.[1]

The first official canicross race in the UK was run in 2000 and in 2002 the first canicross World Championships were held in Ravenna, Italy. The sport is continuing to grow in popularity in Europe as well as Canada. In 2008 canicross made its debut at Crufts with over one hundred runners participating and many races are run every year all across Europe.[2] With the sport

comes the importance for training and conditioning to optimize endurance and the utilization of physiotherapy and other fitness maintenance treatments to enhance athletic performance and decrease the risk of injuries. [3-9]

As with any sport, there is a potential for injury during training and competition, and illness and injuries obtained outside of running may affect athletic performance as well. Studies have been done to investigate demographics and injuries in canine sports such as agility and greyhound racing. A survey of American agility dog handlers conducted in 2009 found that 33% of the 1,627 dogs had been injured, with 58% of the injuries occurring during agility competition.[10] Results of another study on 1,669 agility handlers and 3,801 dogs found that of the agility-related injuries soft tissue strains, sprains, and contusions to the shoulder, back, phalanges, and neck were the most commonly reported injuries.[11] In greyhound racing, of nearly 500 injuries reported at two Massachusetts-based racing tracks, fractures were the most common type of injury making up 74.4% of reported injuries,[12] and it has been previously reported that stress fractures of carpal, metacarpal, tarsal and metatarsal bones are common in these dogs[13-19].These studies show that the potential for injury in canine athletics is high and injury type may vary depending on the sport. Therefore, a canicross specific injury study could be valuable as to date, there is limited information available on dogs involved in canicross. To accomplish this, we surveyed handlers about their dog's participation in canicross. The objectives of this study were to characterize the demographics and injuries incurred by both human and canine canicross runners and determine if there are any associations or risk factors involved in these injuries.

Materials and Methods

A retrospective survey design was used to examine demographic information about dogs and their handlers involved in canicross as well as frequency of competitions and training, and injuries sustained. (Appendix 1, viewable online at www.vcot-online.com http://goo.gl/forms/Nf4aL9T70Q).

The participants were handlers of dogs involved in the sport of canicross. Several canicross organizations were contacted and handlers participated voluntarily. The survey was approved by the Royal Veterinary College Research Ethical Review Board before being released. The responses to the survey were collected between July 21, 2015 and September 11, 2015.

Demographic questions (age, sex, breed of dog), competition information (location, years competing, race distance, competitions/year, number of dogs running with handler, participation in other sports, being retired and why) and questions on competition preparation (frequency of training/week, fitness maintenance, exercises prior and after the race) were included in the survey. Participants were asked about the injuries suffered (number, type and location and recovery status) and effect on their competition activity. The severity of the injuries was classified as mild, if dogs recovered in 1 month or less, and severe if it took more than 1 month. This was based on a previous paper that examined agility-related injury in dogs.[11] Information regarding whether these injuries were evaluated and treated by a veterinarian, or if they were obvious for the handlers and managed by them, was not included in this survey. Similarly, requirement for any veterinary input into the determination of suitability to return to competition was not included in the survey.

Handlers were also asked demographic questions about themselves (age, sex, and years competing), as well as information about injuries sustained.

Descriptive statistics were calculated for several variables. Pearson χ^2 tests of independence and contingency tables were used to examine associations between injury and various factors. For those variables with expected values of 5 or less, Fisher's exact test of independence was used to correct for small sample size. T-tests were used to test for differences between frequency of injury types, location of injury and proportions of injured dogs and humans. Statistical software[a] and a spreadsheet software[b] were used for the analysis. P values < 0.05 were accepted as significant.

Results

A total of 160 surveys were received, some including information on multiple dogs. Answers

were separated for each dog. Characteristics of dogs and handlers are summarized **(Table 1).** Dogs had a mean ± SD age of 4.2±2.3 years (range, 0.7-11.5 years). The most commonly represented sex was male neutered dogs (68/160 [42.5%]) and the majority of dogs primarily competed in canicross events in the UK (147/159 [92.5%]). Dogs most commonly ran as a sole dog with their handler (108/160 [67.5%]).

Mixed breed dogs were the most commonly represented breed (61/166 [36.7%]), followed by the Siberian Husky (13 [7.8%]) and Border Collie (13 [7.8%]), the German Shepherd (8 [4.8%]), and the Labrador Retriever (7 [4.2%]). Of the mixed breed dogs, the most common crosses were Collie (14/46 [30.4%]) and Labrador Retriever crosses (10/46 [21.7%]).

42.5% of dogs (68/160) participated in one or more canine sports in addition to canicross with a total of 19 sports listed. The most common being agility (40/68), bikejor (20/68), and scootering (10/68). In bikejor and scootering the dog is also attached to and pulls the human handler, who is on a bike or a scooter in bikejor and scootering, respectively. Additionally, 33.8% (54 out of 160) of dogs received one or more treatments as fitness maintenance. The most common of these were massage therapy (32/54), hydrotherapy (15/54), and chiropractic (11/54).

The majority of dogs had been running canicross for less than a year (44/159 [27.7%]). Of the dogs that trained for canicross at least once a week, the average number of training days per week was 3.2±1.3 (range, 1-7 days). The mean number of races entered per year was 7.0±6.1 (range: 0-30 races/year), with the most common being 3 races/year (23/159 [14.5%]). The mean±SD distance run was 8.5 ± 7.4 km (range, 3-64.4 km), with the most common distance run being 5 km (69/150 [46.0%]), followed by 10 km (34/150 [22.7%]). Of the 160 responses, 112 dogs (70.0%) did warm up exercises before an event and 79 (49.4%) of dogs did cool down exercises after an event.

The majority of the handlers in the survey were female, with a mean ± SD age of 38.3 ± 9.8 years (range, 16 to 64 years). Handlers' years of experience running in canicross events ranged from less than 1 year to 20 years. The greatest number of participants had been

running with their dog for less than 2 years (57/134 [42.5%]), followed by participants running for 2 to 4 years (49/134 [36.6%]), and participants running 5 years or more (28 /134 [20.9%]).

Out of 160 dogs, 8.1% (13) had been reported with an orthopaedic, neurological, or systemic disease. The most common of these was hip dysplasia (4/13), and epilepsy (3/13). Of these diseases, 3 participants said that the disease interfered with their dog's competition activity. Of the 160 dogs, 21.9% (35) had sustained one or more injuries since they started running canicross. The anatomic location of injuries is summarized in **table 2.** Of these dogs, 24 had incurred one injury, 8 had incurred 2 injuries, and 3 had incurred 3 injuries since they began running canicross. Out of the 49 reported injuries, the most common type of injury was lacerations, abrasions, and punctures (22/49), followed by muscle and tendon injuries (8/49). The most common area for lacerations, abrasions, and punctures was to the footpads (16/22), specifically the footpads of the forelimb (13/16). Dogs had recovered back to full running performance from 38 out of 49 of the injuries. Of the reported recovery times for injuries that had completely recovered, 23 out of 33 took less than a month to recover, while the remainder 10 took greater than one month to recover. Severity and occurrence of injuries is summarized **(Figures 1 and 2)**.

It was found that purebred Labradors were more likely to be injured than other breeds (2-tail p-value= 0.042). All of these injuries were lacerations, abrasions and punctures (3) or nail tears (2), and all occurred while training for canicross. While Labradors accounted for 1.6% (n=2/125) of uninjured participants, they made up 14.3% (n=5/35) of the injured population. No significant association was found between injury occurrence and the other most common breeds, or between injury occurrence in mixed breeds when compared to purebred dogs (p=0.463). When evaluating dogs that also competed in agility and bikejor, there was no significant difference in injury occurrence between dogs that participated in bikejor and those that did not (p-value = 0.150). However, canicross dogs that also participated in agility were more likely to have sustained 2 or more injuries than those that did not (p-value = 0.006). No

significant association with injury occurrence was found with variables such as sex of dog, neutering status, fitness maintenance, warm up and cool down exercises, distance run, number of competitions/year, and number of training days ($p>0.05$). Results of χ^2 analysis indicated that there was a significant difference in injury occurrence between dogs that ran alone with their handler and dogs that sometimes or always ran with another dog during canicross, with dogs that ran as a sole dog being less likely to be injured ($p=0.028$). There was no significant difference in injury occurrence of humans who ran with one dog and humans who sometimes or always ran with two dogs during canicross ($p=0.526$).

Of the human canicross runners, 46.9% (69 out of 147) had suffered one or more injuries while running with their dog. The most commonly reported injuries were ankle injuries (25/69), bruises, cuts, and grazes (20/69), knee injuries (13/69), and hip injuries (7/69). Human runners were significantly more likely to be injured than canines ($p<0.0001$). Results of χ^2 analysis did not indicate a significant correlation between injury status in humans and injury status in the dog with which they run ($p=0.550$).

Humans that have been running in canicross events for 5 years or less were less likely to be injured than those running in canicross for more than 5 years ($p=0.030$). Dogs running in canicross events for greater than 2 years were more likely to have incurred 2 or more injuries than dogs running in events for 2 years or less (2-tail p-value = 0.001).

Discussion

Results of this study indicated that injuries affected approximately 22% of canicross dogs, with 38% of these injuries occurring during canicross training or competition. This is a smaller proportion of dogs than were injured in studies done on agility dogs.[10,11,23] A possible explanation for this result could be that agility dogs have more variation in demands on the body with the many different obstacles they encounter during agility competition and more

191 extreme forces exerted on them while jumping in agility compared to running Canicross.[10,20] In
192 addition, dogs injured during canicross seemed to incur more minor injuries with a shorter
193 recovery time when compared to the studies investigating dogs injured during agility and
194 greyhound racing.[10-12,18] However, this survey study revealed serious injuries that forced the
195 retirement from competition indicating that there is the potential for more serious injury to
196 occur.
197 It was observed that length of time running in canicross had some effect on injury occurrence,
198 as dogs running in canicross events for greater than 2 years were more likely to have incurred
199 2 or more injuries. This is in contrast to results observed in agility dogs, where it has been
200 observed that dogs competing in agility for more than 4 years are at a decreased risk of injury,
201 probably due to an increased expertise and skill acquisition, putting themselves at a lower risk
202 of injury[11]. However, in agility there is a variety of obstacles that would require skill training, in
203 contrast to a more uniform and repetitive activity such that present in canicross. Although skill
204 improvement could decrease the risk of injury in skill demanding sports, it would be reasonable
205 to think that the longer a dog has been participating in a sport, the higher is the likelihood they
206 have suffered one or more injuries in their career. The incidence of injuries in racing
207 greyhounds has been reported to increase during the second year in a survey, but other
208 factors, such as racing track characteristics and racing speed, could also have influenced the
209 risk of injury[21]. Humans running in canicross for greater than 5 years were also more likely to
210 be injured. Injuries in runners have been reported in 17-79% of people, with some variability
211 between men and women, and different factors increasing the risk of injury, such as previous
212 injuries or the use of orthotics[22]. Although both dogs and human runners may develop overuse
213 injuries and stress fractures secondary to their increased activity[14,17,23-25], the intensity of the
214 activity, rather than the duration, may play a more important role in the development of
215 injuries[22,23,26]. However, in the study presented here we did not find a significant relationship
216 between length of races, number of competitions entered per year or training days per week
217 and injuries. Labradors running canicross were more likely to be injured than other dogs, with
218 an odd ratio of 10.25. The proportion of injured Labrador retrievers (14.3%) was much higher

than the proportion of this breed in the study (4.21%). Labrador Retrievers are commonly affected by certain orthopaedic conditions including cranial cruciate ligament disease, hip dysplasia, and elbow dysplasia. [27-30] Some orthopaedic conditions have been reported to alter the kinetics and kinematics of affected animals[31-34] and it is uncertain if these could play a role in the injuries found in this survey study. Dogs that ran with another dog during some or all canicross events were more likely to get injured when compared to those that ran only with a handler. There is no evidence of this happening in other sports where dogs run in groups, such as sled, so it is hypothesized that the presence of two dogs running together may also cause some behavior that is more likely to get a dog injured, such as deviation from a steady running path and interference with gait or twisting of leads due to the presence of two dogs, which could potentiate injury. Canicross dogs that also participate in agility were more likely to incur 2 or more injuries. This suggests that risk factors for injury in canicross dogs may include breed, number of dogs running together in canicross events, and additional participation in agility. While there was no significant association found between injury occurrence and fitness maintenance, or warm up and cool downs during event, there may be differences in the value of different techniques as results of the survey indicated employment of so many diverse fitness maintenance and warm up and cool down techniques.

Lacerations, abrasions, and punctures of the footpads of the forelimb were the most common injury type and site of dogs involved in the survey population. While the forelimb may be more likely to be injured simply because it hits the ground of a potentially hazardous surface before the hindlimb, other mechanisms may also be at work. Further studies are needed to investigate this. Lacerations, abrasions, and punctures can be problematic as they can lead to infection and more serious injuries, which could affect future athletic performance, and therefore prevention is important.[17] Protective paw wear such as boots, particularly for the front paws, may be useful to try to prevent this type of injury. In a study undertaken on working dogs at a rescue site found that footpad injuries was the most common injury in these working dogs (18/20), but paw injuries were not incurred while dogs were wearing paw protection. Recommendations for the development of safe and effective paw protection that does not

hamper agility during this type of work were made in that study. Many of these handlers reported that their dogs wore boots during training.[34] Similarly to these findings, paw protection may possibly be helpful during canicross courses and training in preventing footpad injuries, although further studies would be needed. Protective canine boots are being used on police dogs in Germany and other canine sports such as sled dog racing with a multitude of different brands and designs available for dogs.[35]

Humans participating in canicross were found to be more likely to be injured than their dogs with 47% of canicross human runners in the survey having experienced an injury associated with running with their dog compared to the 22% of canicross dogs that were injured. The most common injuries found in human canicross runners in this survey were injuries to the ankles, knees, and hip as well as bruises, cuts, and grazes. This made lacerations and abrasions a common injury finding in both human and canine canicross runners. This is similar to other studies performed in human runners where incidence of injury varies between 19.4% to 79.3%, and the lower extremity is a common site for injuries [22,24]. A study looking into injuries among handlers and dogs competing in agility, also found a higher occurrence of injury in the handlers (14.1%) in comparison with the dogs (8.81%), with similar injuries to our study[25]. There is the possibility that human reported injuries may be greater and more specific partially due to ability of humans to communicate the specific pain, which is a limitation when reporting canine injury, however, as there was such a large proportion of humans injured from running with their dogs with 25 different human injury types reported in this study, future studies looking at human injury and risk factors in canicross are warranted.

Limitations of the present study should be evaluated when interpreting the results. The accuracy of these findings depends on handler-reported data and recall compared to veterinary confirmed injuries. Another limitation is self-selection bias as survey respondents volunteered to participate in the survey. It is possible that handlers with a greater interest or personal experience with dogs injured in canicross were more likely to complete the survey. However, studies have found that self-selected survey respondents who care about the issue

being studied are more likely to provide complete and higher quality data than randomly-selected respondents.[36,37] There was no confirmation that the injuries encountered by the dogs had been evaluated or treated by veterinarians. Although the more obvious injuries, such as lacerations and abrasions, or nail tears, could have been easily identified by the handlers, other more subtle injuries could have been missed or wrongly localized by the handlers and therefore not have been properly diagnosed by a veterinarian, and reported in this survey. The majority of injuries found were self-evident, so it is hoped this limitation wouldn't change the results of this study greatly. Similarly, there was no requirement for any veterinary input into the determination of suitability of a dog to return to competition, so it is unknown if this decision was made on the basis of a veterinarian evaluation or not. It has been reported that subjective lameness evaluation differs among evaluators, even experienced ones, and it is poorly correlated to objective evaluation of gait.[38,39] However, in addition to lameness evaluation, veterinarians usually perform an orthopaedic examination, which could have influenced further the decision. If the decision to return the dog to competition was made by the handler, other factors, such as competitive or economical reasons could have biased the choice. It is unclear how all these factors would have influenced the decision to return a dog to competition, and the results of this study.

Return to competition is one of the ultimate goals in recovery from athletic injury, which is not a consideration with non-competition pets. Return to competition after injury was high in canicross dogs in this survey population with 84% of injured dogs having recovered back to full running performance. However, the athletic performance of most of the injured dogs was affected while they had the injury. The results of this study also suggest that risk factors for injury in canicross dogs may include breed, number of dogs running together in canicross events, and additional participation in agility.

Footnotes

a. SPSS

b. Microsoft Excel

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A copy of the survey form used is available at: http://goo.gl/forms/Nf4aL9T70Q.

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TABLES

40. Characteristic	No. (%) of Responses
Sex of Canine	
Male neutered	68 (42.5%)
Male entire	27 (16.9%)
Female spayed	58 (36.3%)
Female entire	7 (4.4%)
Number of dogs running with handler during competition	
1	

2	108 (67.5%)
1 or 2	36 (22.5%)
	16 (10,0%)
Number of years dog has been running Canicross	
<1	
1	44 (27.7%)
2	35 (22.0%)
3	30 (18.9%)
4	18 (11.3%)
5	12 (7.5%)
6	8 (5.0%)
7	6 (3.8%)
8	0 (0.0%)
9	2 (1.3%)
10	2 (1.3%)
>10	1 (0.6%)
	1 (0.6%)
Frequency of canine Canicross practice (no. of times/wk)	
<1	
1	3 (1.9%)
	10 (6.3%)
2	41 (25.8%)
	59 (37.1%)
3	18 (11.3%)
	19 (11.9%)
4	6 (3.8%)
	3 (1.9%)
5	
6	
7	
Sex of Handler	
Male	29 (21.8%)
Female	104 (78.2%)
Region	

UK	147 (92.5%)
North America	9 (5.7%)
other European country	3 (1.9%)

Percentages are based on the total numbers of responses for each category: sex of canine (n=160), number of dogs running with handler during competition (160), number of years dog has been running Canicross (159), frequency of canine Canicross practice (159), sex of handler (133), Region (159).

Table 1- Selected characteristics of Canicross dogs and their handlers.

Anatomic location	No. (%) of Injuries
footpads	16 (32.7%)
of forelimb (13)	
of hindlimb (3)	
nails	5 (10.2%)
of forelimb (1)	
of hind limb (4)	
shoulder	5 (10.2%)
stifle joint	4 (8.2%)
forearm (antebrachium)	3 (6.1%)
phalanges	2 (4.1%)
of forelimb (1)	
of hind limb (1)	
back	2 (4.1%)
lower thigh	2 (4.1%)
carpal joint	1 (2.0%)
tarsal joint	1 (2.0%)
neck	1 (2.0%)
chest	1 (2.0%)
elbow	1 (2.0%)
flank	1 (2.0%)
hip	1 (2.0%)
patella	1 (2.0%)
upper thigh	1 (2.0%)
hind limb (unspecified)	1 (2.0%)

Table 2- Anatomic Location of 49 reported injuries in Canicross dogs

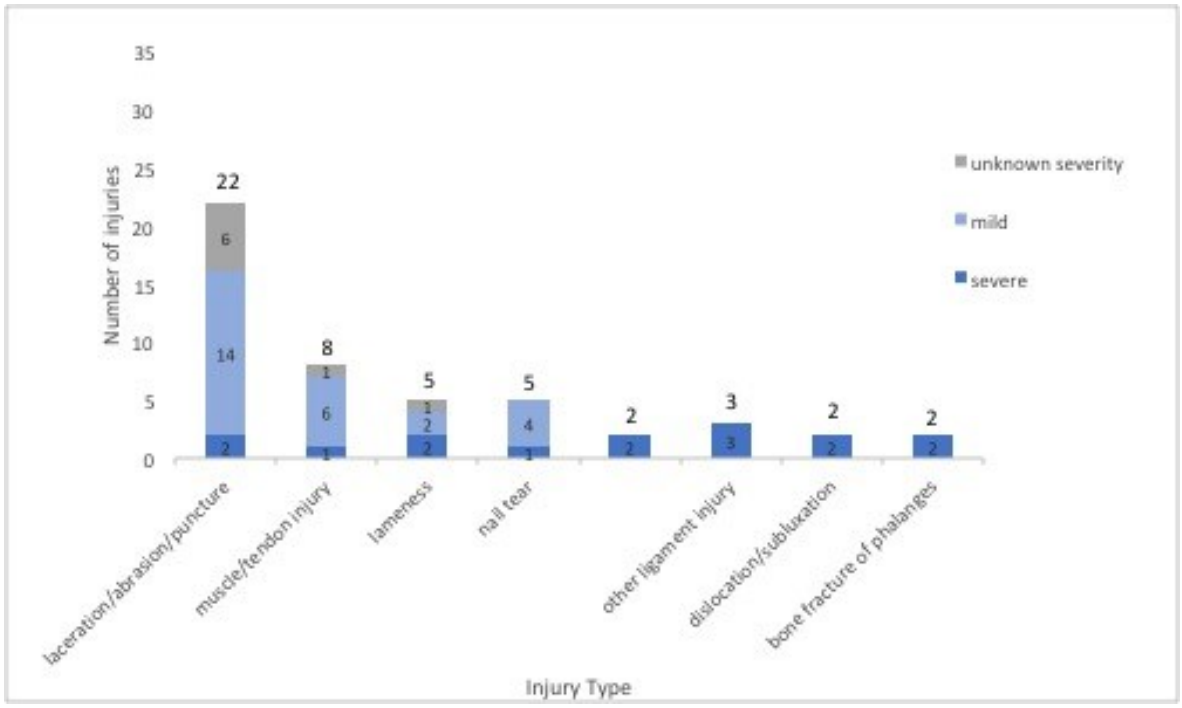

Figure 1-Type and severity of reported injuries in Canicross dogs. Severe injuries are classified as those taking greater than 1 month to recover and current injuries that have not yet recovered and have been ongoing for greater than 1 month. Mild injuries are classified as those that took 1 month or less for recovery. Injuries in which the recovery time was not specified or injuries that have been ongoing for less than 1 month are classified as unknown severity. Results of χ^2 analysis with Yates correction for continuity indicated significant difference in severity across injury types (p=0.009).

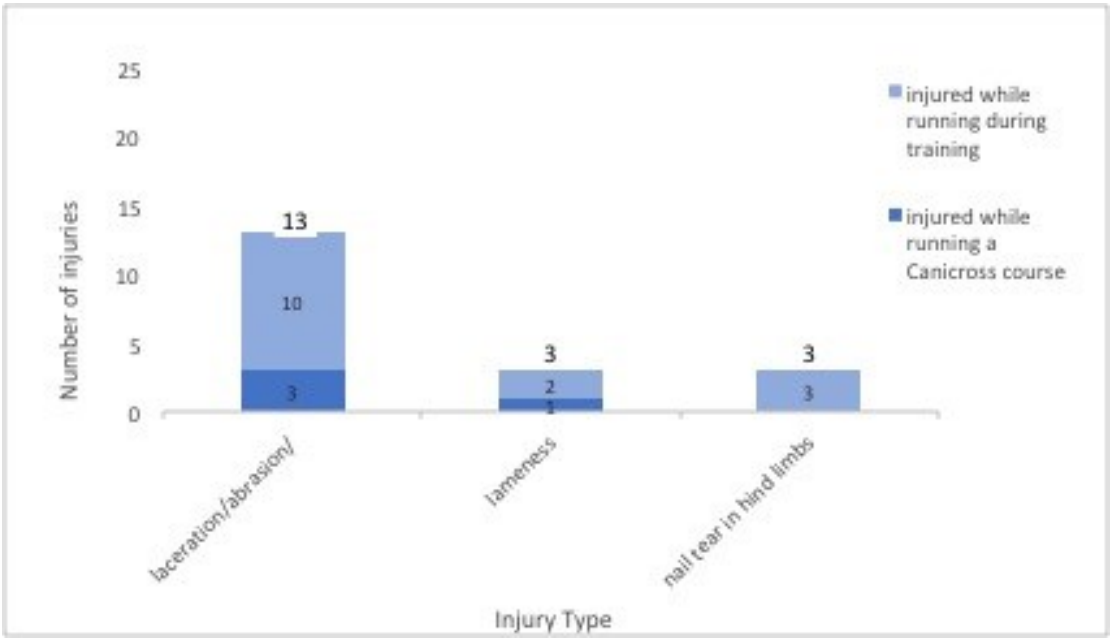

Figure 2-Type of injuries reported in Canicross dogs where injury was known to have occurred during Canicross training or during Canicross course running.