

Characteristics of intrahousehold interdog aggression and dog and pair factors associated with a poor outcome

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OBJECTIVE

To describe characteristics of intrahousehold interdog aggression (IDA) and dog and pair factors associated with a poor outcome (permanent separation, rehoming, or euthanasia of dogs).

ANIMALS

305 pairs of dogs (610 dogs) with IDA.

PROCEDURES

The record database of a referral veterinary behavioral clinic was searched to identify pairs of dogs that were evaluated for IDA (IDA pairs) between September 2007 and September 2016. A standardized form was used to extract data for each IDA pair, including signalment and acquisition order of both dogs, history of IDA, behavioral interventions implemented, and outcome. Descriptive data were generated. Univariable logistic regression was used to identify factors associated with a poor outcome.

RESULTS

Most IDA pairs included at least 1 female dog (214/305 [70%]) and dogs of the same sex (188/305 [61.6%]). Resource guarding was the most common fight trigger (222/305 [72.8%]). Possessive aggression (guarding of physical resources) was the most common comorbidity for individual dogs (216/610 [35.4%]). The aggressor was acquired after the recipient in 181 of 305 (59.3%) pairs. Aggressors were a mean of 16 months younger and 1.5 kg (3.3 lb) heavier than recipients. Factors associated with a poor outcome included pairs of the same sex, history of bites that broke the skin, and aggression on sight of the recipient.

CONCLUSIONS AND CLINICAL RELEVANCE

Results suggested that behavior intervention should be provided quickly for IDA pairs with a history of bites that break the skin or uninhibited attacks on sight owing to the high risk for a poor outcome. Owners should be advised to avoid same-sex pairs during preadoption counseling. (*J Am Vet Med Assoc* 2020;256:349–361)

Aggression between dogs in the same household creates upheaval within a dog owner's home, erodes the human-animal bond, and often leads to rehoming or euthanasia of 1 or both dogs.¹ Households in which an amicable relationship cannot be achieved between dogs might have to resort to keeping the dogs separated permanently or when they are unsupervised.¹ Alternatively, owners may choose to keep 1 or both dogs muzzled when they are together. All of those alternatives can become burdensome for the household owing to the management required to maintain safety. Lapses in management can result in serious injury to the dogs or people in the household, and concern about such lapses adds stress to the daily

lives of dog owners. Prognostic information regarding the likelihood of achieving a safe and positive resolution to IDA would be beneficial to owners and might help guide treatment or action early in the decision-making process. Although multiple studies^{2-7,a} have investigated IDA within individual households, only a couple^{3,a} have evaluated prognostic indicators for the outcome of IDA. Results of those studies suggest that IDA is less likely to improve when triggers for aggression between dogs are unpredictable,³ when the aggressor is younger than the recipient dog,³ when humans are injured trying to break up fights between dogs,³ and when aggressive episodes occur more frequently than on a weekly basis.^a

In households with IDA, female dogs are more likely than male dogs to be involved in aggressive episodes⁸⁻¹⁰ and to be more aggressive, which frequently translates into more severe injuries and a greater likelihood for a poor outcome.¹¹ Overrepresentation of female dogs as aggressors in IDA is notable because male dogs are often the aggressors in other behavioral-related diagnoses.^{8,9,12-17} Almost 70% of dog pairs with IDA (IDA pairs) involve dogs of the same sex, with FF

ABBREVIATIONS

AKC	American Kennel Club
AR	Aggressor-recipient
CI	Confidence interval
FF	Female-female
IDA	Interdog aggression
MF	Male-female
MM	Male-male
TBC	The Behavior Clinic LLC

pairs being the most common.^{2,3} Female dogs are often identified as the aggressor in IDA pairs.^{3,8,a} Results of 1 study³ also indicate that female dogs are more likely to inflict injuries that require medical attention, although the frequency of those types of injuries was not associated with the probability of a poor outcome in that study. Within IDA pairs, the aggressor is frequently younger¹⁸ and is likely to have been acquired or introduced into the household more recently than the recipient,^{2,3} regardless of sex. The interaction between FF pairs is less likely to improve following treatment than is the interaction between MF or MM pairs.² When the Canine Behavioral Assessment and Research Questionnaire is used, female dogs generally score higher than male dogs on questions related to canine-directed aggression (ie, are subjectively more aggressive).¹⁹ Even though improvement of IDA is less likely to occur when the aggressor is younger than the recipient,³ to our knowledge, the likelihood of improvement in IDA when the dogs involved are the same age or when there is a profound difference in age has not been investigated.

Reported triggers for aggressive episodes, or fights, include resources (eg, food, toys, and discovered items), proximity and attention from owners, attention from nonfamily members, proximity in confined spaces, and excitement, especially during greetings, play sessions, walks, and rides in vehicles.^{2,3,20} Results of 1 study³ indicate that poor IDA outcomes (eg, complete separation of dogs, euthanasia, or rehoming) are more common when fight triggers are poorly identified or unpredictable; however, initial fight frequency (ie, prior to an initial behavioral consultation and recommended separation of dogs) and fight intensity were not associated with the IDA outcome for the dogs of that study.

In dogs, a breed-specific propensity for canine-directed aggression is well described.^{14,15,19,21-24} It has been postulated that IDA may result from a lack of communication or miscommunication between the dogs involved and that an inappropriate social display may lead to aggressive encounters.^{9,23} Various behaviors have been evaluated for association with a dominant-subordinate relationship among dogs of the same breed.^{9,23} Some signals believed to be associated with relationship status are changes in posture (eg, stiffening of the body, an upright posture, and passing over the head and neck of the other dog vs cringing and reducing body size), oral displays (eg, muzzle bites vs facial licking), and tail movements (eg, tail held high vs tucked).^{23,25} Impaired social communication may be caused by natural (eg, brachycephalic conformation or long ears) or imposed (eg, docked tail or ears) phenotypic variations. Assuming phenotypic variations may affect behaviors that contribute to dominant-subordinate relationships, then dogs with a compromised phenotype (eg, docked tail) may have impaired signaling capacity, which could lead to an increase in the risk for fighting.^{9,23,24,26}

In veterinary behavioral medicine, psychopharmacology, desensitization, counterconditioning, manage-

ment, safety, and avoidance are critical to successful therapy.⁹ Management prevents a patient (typically the aggressor) from exhibiting the problem behavior and mitigates injury as well as subsequent fear-provoking interactions with the recipient. In previous studies,^{2,3} fight intensity was measured by injury but was not associated with outcome. However, injury occurred in 57 of 73 (78%) IDA pairs assessed in 1 study,³ and medical treatment was sought for injuries involving 1 or both dogs of 15 of 30 (50%) IDA pairs described in another study.² The use of muzzles can prevent bite injuries between dogs of IDA pairs.⁹ Other techniques for management of IDA pairs are intended to prevent conflict and injury between dogs by means of separation, such as with baby gates, doors, fences, and leashes.⁹ Use of that type of equipment not only separates dogs from each other, but it also generally separates 1 or both dogs from people within the household. Comorbid separation anxiety or fear of confinement can make management of IDA difficult and has been reported to occur in about half of IDA pairs.² The ability to prevent fights is important and any comorbid diagnoses that inhibit the ability to manage dogs with IDA can lead to a poor outcome. Goals for treatment of IDA include prevention of injury and freedom from fear for both dogs and humans.²⁷ When an aggressor attacks a recipient on sight and without inhibition (uninhibited attack), management of IDA must be escalated to include visual segregation. That increases the stress and burden for the family but is essential to ensure the welfare of all dogs living within the household. However, the need for visual segregation may lead to a poor outcome because the additional workload for the human members of the household might lead to rehoming or euthanasia rather than treatment of the involved dogs. Studies of factors that might alter management and prevention of IDA are lacking; therefore, the provision of optimal counseling for owners of IDA pairs is difficult.

The goal of the study reported here was to gather descriptive characteristics regarding intrahousehold IDA pairs from a large private practice database and provide current data regarding individual dog and pair factors associated with a poor outcome (permanent separation, rehoming, or euthanasia of involved dogs). We hypothesized that a poor outcome would be associated with the following: brachycephalic phenotype in at least one of the involved dogs, a comorbid diagnosis of separation anxiety or fear of confinement, fights that resulted in dog bites that broke the skin, FF pairs, aggression on sight of the recipient, and unknown or unavoidable fight triggers.

Materials and Methods

Case selection criteria

The electronic database of TBC was searched to identify dogs that were evaluated for canine aggression between September 20, 2007, and September 20, 2016. Dogs that were evaluated because they reportedly showed aggression toward or were subject to

aggression from another dog within the same household were considered for the study. Dogs were excluded from the study when there was insufficient data for both dogs of the IDA pair and the missing data could not be obtained from subsequent recheck consultations or medical records from the referring veterinarian that dated back to the observation period. Dogs were also excluded from the study when a history form was not completed prior to the initial behavioral consultation.

Behavioral consultations and interventions

All dogs were evaluated and treated by the same veterinarian (ESMF), and all consultations involved that veterinarian and a registered veterinary technician. One or both dogs of an IDA pair were evaluated during an initial consultation that lasted for 2 to 3 hours. That consultation included review of a 10-page history questionnaire that was completed by the owner prior to the consultation, discussion of behavioral problems with the owner, and observation of the dog or dogs. Owners provided data for each dog in an IDA pair. Those data were recorded in a standardized form throughout the study period and included signalment (breed, age, weight, sex, and reproductive status), duration of ownership, source of acquisition, and whether the dog was a singleton pup or was bottle fed. Owners were also asked whether they were considering euthanasia. All consultations were held at TBC or, less commonly, within the owner's home.

A treatment plan was developed for each pair of dogs. Individual dog diagnostic testing including a CBC, serum biochemical profile, thyroid panel, and urinalysis was required to be performed within 6 months before the initial behavioral consultation or repeated when abnormalities were identified on prior diagnostic tests before administration of any medication was initiated.

Typical treatment of intrahousehold IDA included counseling the owner about the problem and designing a management plan focused on the safety of both the owners and dogs involved to avoid injury and prevent situations that trigger aggressive interactions. All dogs were provided with positive reinforcement-based behavioral therapy that included obedience training, desensitization and counterconditioning to problematic stimuli, and response substitution through a cue-response-reward interaction between owner and dog as described.^{2,4} Some owners were advised to muzzle train 1 or both dogs on the basis of previous bite scores, fight frequency, predictability and ability to avoid aggression triggers, and the owner's physical ability to break up dog fights. Serotonergic medications were often prescribed as adjunct treatments within the overall plan as described.^{2-4,20,28-32}

Owners were offered 12 months of unlimited email follow-up and 12 months of limited telephone follow-up as part of the treatment plan (1 telephone call was scheduled with the veterinarian or a registered veterinary technician once monthly). All re-

sponses to follow-up emails and telephone conversations were directed and reviewed by the veterinarian to guide treatment changes (eg, addition of behavior therapy steps with provision of handouts and recommendations for technician appointments, adjustments to medication regimens, and review of videos from training sessions). A recheck consultation with the veterinarian was recommended every 2 months and was required at least every 4 months after the initial consultation. Recheck appointments with a registered veterinary technician for counseling regarding the implementation of management and safety techniques and adjustments to the behavioral modification plan (eg, muzzle training support; head-halter fitting, training, and support; counterconditioning sessions; confinement training; and target training to a location) were recommended every 4 weeks after the initial consultation for as long as needed.

Data collection

Prior to study initiation, investigators created a standardized form to systematically collect data from the records of eligible dogs. All data were extracted from the medical records by 1 individual who was unaware of the hypotheses being investigated.

Individual dog data were obtained from the history questionnaire completed by the owner prior to the initial behavior consultation and from owner-provided answers to questions asked during the initial consultation. For each dog, weight was recorded as the body weight obtained from TBC record at the time of the initial consultation or, when weight was not recorded at the time of the initial consultation, the body weight obtained from the referring veterinary clinic's record at the date of the referral. Sex and reproductive status (sexually intact or neutered) were also recorded.

Dogs were designated as either an aggressor (ie, initiator, instigator, or first dog to growl, snarl, or bite) or recipient (receiver of aggression) during the initial behavioral consultation on the basis of information provided by the owner and observation by the veterinarian at that time or during review of videotaped recordings of IDA pair interactions. For IDA pairs in which both dogs initiated aggressive postures and fights, both were designated as aggressors, and a clear AR status for the pair was not established. When the aggressor or recipient status of a dog changed at some point before or after the initial consultation, the dog was classified according to the status at the initial consultation and was noted to have switched AR status. In instances where the owner or veterinarian determined that the recipient fought back, that dog was labeled as defensively aggressive. Any familial relationship between dogs within each IDA pair as reported by the owner was also recorded.

The breed of each dog was determined by information provided by the owner. A dog that was not of an AKC-recognized breed was designated as a mixed-breed dog when it was a combination of > 2 breeds

or at least 1 of the contributing breeds was unknown. Both breeds were recorded for known 2-way cross-breeds. Purebred dogs were further categorized by AKC-recognized groups (working, herding, hound, sporting, terrier, toy, and nonsporting). Dogs were also classified as brachycephalic or nonbrachycephalic on the basis of phenotype. A dog was classified as brachycephalic if it was a purebred or a combination of at least one of the following breeds: Affenpinscher, American Bulldog, Boston Terrier, Boxer, Brussels Griffon, Bullmastiff, Cavalier King Charles Spaniel, Chihuahua, English Bulldog, English Mastiff, English Toy Spaniel, French Bulldog, Japanese Chin, Lhasa Apso, Neopolitan Mastiff, Pekingese, Presa Canario, Pug, Shih Tzu, Tibetan Spaniel, or Valley Bulldog. Dogs of unknown breeds or unknown breed mixes were excluded from that classification. Each IDA pair was also categorized on the basis of whether the dogs were of the same breed or different breeds.

The age (in months) of each dog was recorded at the time of the initial behavioral consultation. Dogs within each IDA pair were also categorized on the basis of the difference in age between the aggressor and recipient as follows: aggressor older than the recipient, aggressor 0 to 23 months younger than the recipient, and aggressor > 23 months younger than the recipient.

For each IDA pair, the most severe bite observed between the dogs was scored on a scale of 1 to 6 as described² (**Appendix**). Bites that did not break the skin were assigned a score of 2, whereas bites that broke the skin were assigned a score of at least 3. The same system was used to assign bite scores to individual dogs with a minor modification; recipients that did not fight back were assigned a bite score of 0. Aggressors were also categorized as to whether they did or did not become aggressive on sight of the recipient (ie, triggered by sight of the recipient, uninhibited attack, or engagement without hesitation).

Fight triggers were recorded for each IDA pair on the basis of information obtained from the owner-provided history or observation during the initial consultation. Triggers were classified as guarding of physical resources (ie, food, dog bed, toys, or found objects), owner proximity or attention, tight or confined space, excitement or arousal, unknown, unavoidable (eg, human sneeze or vomiting of other dog in the household), and the return of 1 dog of the pair after an absence. A category called other was also provided for descriptions of triggers that did not fall within the defined classifications.

Descriptive data regarding ancillary diagnoses and antecedent stimuli, such as separation anxiety, aggression toward unfamiliar dogs, aggression toward unfamiliar people, fear of unfamiliar people, generalized anxiety, global fear, fear of confinement, possessive aggression (ie, guarding of physical resources), owner-directed aggression, or noise phobia were recorded. Information regarding treatment or management of IDA before

the initial consultation and at the time of last contact was recorded and categorized as was the outcome. This information included whether the dogs were never separated, separated for triggers, separated when unsupervised and for triggers, or always separated. Also recorded was whether the dogs were muzzled when they were together, whether a muzzle was recommended, when a muzzle was purchased, and when muzzle training was deemed complete by TBC (defined as a dog wearing the muzzle for ≥ 10 minutes without signs of distress or attempts to remove it). All muzzles used at and recommended by TBC were basket style, and the basket was composed of steel wire, vinyl, or rubberized plastic material.

For each dog, outcome was recorded as rehomed, euthanized because of behavior, euthanized because of medical reasons, or unknown on the basis of information obtained at the time of last contact with the patient or owner. For each IDA pair, outcome was defined as poor when 1 or both dogs were euthanized because of behavior, rehomed, or had to be kept completely separate at the time of last contact. Outcome was defined as positive when neither dog was euthanized or rehomed and the dogs did not have to be kept completely separate at the time of last contact. Euthanasia because of medical problems and unknown outcomes were excluded from outcome analyses.

Data analysis

Descriptive statistics were computed for all variables. Continuous data for age and weight were visually assessed for normality. Data for all other continuous variables and ordinal or categorical variables with multiple response groups were categorized into 7 or fewer categories on the basis of biological relevance or data quartiles. Paired *t* tests were used to compare age and weight between aggressors and recipients of IDA pairs. For all other pair-level analyses, individual dog data were collapsed to the pair level (eg, presence of brachycephalic phenotype within pair [yes or no], sex of case pair [FF, MM, or MF], and switched AR status [yes or no]). For IDA pairs with a clearly defined aggressor and recipient, the proportion in which the recipient was acquired before the aggressor was calculated and compared with a null value of 50% by means of a 2-sided 1-sample test of proportion. Pairs in which the aggressor and recipient could not be clearly defined were excluded from that analysis and all other analyses involving AR status. Univariable logistic regression was used to determine whether demographic or behavioral variables were associated with a poor outcome, and results were reported as the ORs and associated 95% CIs. Only IDA pairs with at least 6 months of follow-up information or a known outcome (at least 1 dog euthanized or rehomed within 6 months after the initial behavioral consultation) were included in analyses of factors associated with a poor outcome (outcome analyses). Data for IDA pairs with < 6 months of follow-up infor-

mation available and in which 1 dog was not euthanized, rehomed, or permanently separated from the other dog in the pair were included in the descriptive analyses but were excluded from the outcome analyses. Values of $P \leq 0.05$ were considered significant for all analyses. All analyses were performed with commercially available statistical software.^b

Results

IDA pairs

Three hundred five cases involving intrahousehold IDA (ie, 610 dogs) were evaluated during the observation period. All 305 IDA pairs were included in the descriptive analyses, but only 217 IDA pairs (434 dogs) were included in the outcome analyses. Twenty-three IDA pairs were excluded from the outcome analyses because of incomplete individual data for 1 or both dogs in the pair; that included 4 pairs for which the owner brought a dog to TBC for preadoption counseling after having previously managed IDA involving an existing dog in the household. Thirty-two IDA pairs were excluded because < 6 months of follow-up information was available, and another 33 IDA pairs were excluded owing to an unconfirmed outcome. The mean \pm SD duration of treatment provided by TBC was 18.3 ± 19.7 months (median, 12 months; range, 0 to 110 months) for all 305 IDA pairs and 25 ± 19.8 months (median, 19 months; range, 1 to 110 months) for the 217 IDA pairs included in the outcome analyses.

Descriptive data

Among the 610 dogs evaluated, 311 (51%) were females (297 spayed and 14 sexually intact) and 299 (49%) were males (284 neutered and 15 sexually intact). Of the 311 female dogs, 178 (57%) were classified as aggressors, of which 7 (3.9%) were sexually intact. Of the 299 male dogs, 163 (54.5%) were classified as aggressors, of which 6 (3.7%) were sexually intact (**Table 1**). One hundred twenty-eight (21.0%) dogs had a brachycephalic phenotype.

Three hundred thirty-one (54.3%) dogs were purebreds, and 279 (45.7%) were mixed-breed dogs (**Table 2**). Among the purebred dogs, the most commonly represented breeds were Boxer ($n = 32$), Pug (16), Jack or Parson Russell Terrier (16), German Shepherd Dog (13), Labrador Retriever (13), Golden Retriever (12), Beagle (11), Boston Terrier (10), and English Bulldog (10). Three hundred forty-one of the 610 (55.9%) dogs were definitively classified as aggressors, and 269 (44.1%) were definitively classified as recipients. One hundred eighty-three of the 341 (53.7%) aggressors and 148 of the 269 (55.0%) recipients were purebred dogs. Most dogs were obtained from a shelter or rescue organization ($n = 263$ [43.1%]) or breeder (225 [36.9%]).

Of the 305 IDA pairs evaluated, the sex distribution was MF for 117 (38.4%), FF for 97 (31.8%), and MM for 91 (29.8%). The dogs of 23 (7.5%) pairs were genetically related; 15 (4.9%) pairs consisted of lit-

termates, 5 (1.6%) pairs consisted of dam or sire and offspring, and 3 (1.0%) pairs consisted of cousins. Ninety-three (30.5%) IDA pairs had at least 1 dog with a brachycephalic phenotype. Ninety-five (31.1%) IDA pairs involved dogs of the same breed. Both dogs were classified as aggressors in 36 (11.8%) IDA pairs evaluated. Owners of 15 (4.9%) pairs reported that, after the IDA began, they noticed that the aggressor became the recipient and vice versa (ie, AR status switched; **Table 3**). The AR status did not switch for any pair after the initial behavioral consultation.

For 121 of the 305 (39.7%) IDA pairs evaluated, at least 1 dog of the pair was absent during the initial behavioral consultation. The dogs that were present during the initial behavioral consultation were generally aggressors rather than recipients.

Triggers and comorbid diagnoses

Resource guarding was the most common trigger for aggressive episodes within IDA pairs (**Table 4**). Possessive aggression, which included guarding of physical resources and food, was the most common comorbid diagnosis for individual dogs within IDA pairs (**Table 5**). Other common triggers for aggression within pairs included arousal and excitement and confined space. However, aggression triggers for a substantial portion of the 305 pairs evaluated (69/305 [22.6%]) appeared to be uncontrollable and remained unidentified or were unavoidable. Other common comorbid diagnoses for individual dogs included aggression toward unfamiliar people (127/610 [20.8%]), noise phobia (123/610 [20.2%]), and aggression toward unfamiliar dogs (122/610 [20.0]).

Management and treatment of IDA

For the 305 IDA pairs at the time of the initial behavioral consultation, owner-initiated management of IDA included keeping the dogs completely separated at all times ($n = 68$ [22.3%] pairs), keeping the dogs separated during known triggers (48 [15.7%]), and keeping the dogs separated when they were unsupervised and during known triggers (6 [2%]). Dogs were never separated prior to the initial consultation for 183 of the 305 (60%) pairs. Behavioral intervention varied. Muzzles were recommended for 183 of the 341 (53.7%) aggressors and 44 of the 269 (16.4%) recipients. Among the 434 dogs with known outcomes, muzzles were purchased for 100 of 243 (41.5%) aggressors and 24 of 191 (12.6%) recipients, but only 32 aggressors and 8 recipients completed muzzle training. Two hundred eighty-one of the 341 (82.4%) aggressors and 88 of the 269 (32.7%) recipients were prescribed psychotropic medications. One hundred eighty-nine and 180 dogs were prescribed monopharmaceutical and polypharmaceutical treatment, respectively. Psychopharmaceuticals administered included fluoxetine, sertraline, paroxetine, citalopram, clomipramine, amitriptyline, venlafaxine, gabapentin, clonidine, trazodone, alprazolam, and lorazepam.

Behavioral intervention outcome

Of the 434 dogs with known outcomes, 24 (5.5%) were euthanized because of behavioral problems and

Table 1—Descriptive data for 610 dogs that comprised 305 pairs of dogs that were treated for intrahousehold IDA aggression (IDA pairs) by 1 referral veterinary practice limited to evaluation of pets for behavioral problems between September 2007 and September 2016.

Variable	Category	All 305 IDA pairs		217 IDA pairs included in outcome analyses*	
		No. of dogs with available data	Value	No. of dogs with available data	Value
Age at initial behavior consultation (mo)	All dogs	610	59.3 ± 39.3 52 (2.3–204)	434	48.5 ± 38.7 52 (2.3–204)
	Aggressors	341	52.3 ± 34.0 47 (3–174)	243	52.1 ± 32.6 45 (5–142)
	Recipients	269	68.1 ± 44.8 60 (2.3–204)	191	65.5 ± 44.3 60 (2.3–204)
Age at acquisition (mo)†	All dogs	561	10.3 ± 16.7 3 (0–110)	399	10.3 ± 16.0 3 (0–108)
	Aggressors	337	10.5 ± 16.1 3.2 (0–108)	241	10.2 ± 14.9 3.5 (0–108)
	Recipients	224	10.0 ± 17.6 2.8 (0–110)	158	10.4 ± 17.7 2.8 (0–96)
Body weight (kg)	Aggressors	341	22.6 ± 13.2 22.7 (2.3–73.1)	243	22.1 ± 13.0 21.4 (3.2–73.1)
	Recipients	269	21.7 ± 13.5 21.6 (0.9–80)	191	21.3 ± 13.8 0.9 (0.9–80)
Sex	Female	610	311 (51)	434	213 (49)
	Male		299 (49)		221 (51)
Reproductive status (all dogs)	Sexually intact male	610	15 (2.5)	434	12 (2.8)
	Neutered male		284 (46.6)		209 (48.2)
	Sexually intact female		14 (2.3)		8 (1.8)
	Spayed female		297 (48.7)		205 (47.2)
Reproductive status (aggressors)	Sexually intact male	341	6 (1.8)	243	5 (2.1)
	Neutered male		157 (46.0)		115 (47.3)
	Sexually intact female		7 (2.1)		3 (1.2)
	Spayed female		171 (50.2)		120 (49.4)
Reproductive status (recipients)	Sexually intact male	269	9 (3.4)	191	7 (3.7)
	Neutered male		127 (47.2)		94 (49.2)
	Sexually intact female		7 (2.6)		5 (2.6)
	Spayed female		126 (46.8)		85 (44.5)
Defensive aggression	Yes	268	44 (16.4)	190	31 (16.3)
	No		224 (83.6)		159 (83.7)
Bite score	Aggressors	341	2.6 ± 1.2 2 (1–6)	243	2.5 ± 1.2 2 (1–6)
	Recipients	269	0.8 ± 1.4 0 (0–5)	191	0.7 ± 1.3 0 (0–5)
Brachycephalic phenotype	Yes	610	128 (21.0)	434	128 (29.5)
	No		482 (79.0)		306 (70.5)
Source	Breeder	610	225 (36.9)	434	160 (36.9)
	Shelter-rescue		263 (43.1)		191 (44.0)
	Relative-friend		44 (7.2)		33 (7.6)
	Owner bred parents		11 (1.8)		8 (1.8)
	For sale listing		12 (2.0)		9 (2.1)
	Pet store		21 (3.4)		13 (3.0)
	Stray		27 (4.4)		18 (4.1)
	Other		7 (1.1)		2 (0.5)
Singleton puppy, bottle fed, or orphan	Yes	195	7 (3.6)	147	5 (3.4)
	No		188 (96.4)		142 (96.6)

Values represent mean ± SD and median (range) or number (percentage) of dogs within the given variable or category. Some dogs had missing data for some variables; therefore, the number of dogs varies among variables. Within a variable, percentages may not sum to 100 because of rounding.

*There were 217 IDA pairs (434 dogs) for which there was > 6 months of follow-up information available or that had a known poor outcome (ie, at least one of the dogs was rehomed or euthanized within 6 months after initial behavioral consultation). †Includes dogs that were born on the owner's property.

another 24 died or were euthanized because of medical problems. Five IDA pairs had a known outcome but were followed for < 6 months after the initial behavioral consultation. In all 5 of those pairs, 1 dog was euthanized because of behavioral problems.

At the time of data analysis, the behavioral intervention outcome was unknown for 30 of the 305 (9.8%) IDA pairs evaluated and poor for 73 (23.9%). Of the 73 IDA pairs with a poor outcome, the dogs

of 36 (49.3%) pairs had to be kept completely separate at all times, whereas at least one of the dogs had been rehomed or euthanized for behavioral reasons for 13 (17.8%) and 24 (32.9%) pairs, respectively. For the remaining 202 IDA pairs, 121 never had to be kept separated following the behavioral intervention, whereas 41 had to be kept separated during triggers, 27 had to be kept separated when they were unsupervised and during triggers, and 13

Table 2—Breed information for the dogs of Table 1.

AKC group	Breed	All 305 IDA pairs	217 IDA pairs included in outcome analyses
Sporting	All breeds combined for group	42 (6.9)	31 (7.1)
	Labrador Retriever	13 (2.1)	8 (1.8)
	Golden Retriever	12 (2.0)	9 (2.1)
Working	All breeds combined for group	67 (11.0)	52 (11.9)
	Boxer	32 (5.2)	25 (5.8)
	Doberman Pinscher	8 (1.3)	5 (1.2)
Nonsporting	All breeds combined for group	53 (8.7)	32 (7.4)
	Boston Terrier	10 (1.6)	8 (1.8)
	English Bulldog	10 (1.6)	1 (0.2)
Herding	All breeds combined for group	48 (7.9)	36 (8.3)
	German Shepherd Dog	13 (2.1)	8 (1.8)
	Border Collie	9 (1.5)	9 (2.1)
Toy	All breeds combined for group	44 (7.2)	35 (8.1)
	Pug	16 (2.6)	15 (3.5)
	Shih Tzu	7 (1.1)	7 (1.6)
Terrier	All breeds combined for group	39 (6.4)	26 (6.0)
	Jack or Parson Russell Terrier	16 (2.6)	12 (2.8)
	West Highland White Terrier	4 (0.7)	1 (0.2)
Hound	All breeds combined for group	32 (5.2)	17 (3.9)
	Beagle	11 (1.8)	5 (1.2)
	Dachshund	9 (1.5)	7 (1.6)
—	Purebred dogs of breeds not classified to an AKC group*	6 (1.0)	0 (0)
—	Mixed-breed dog	279 (45.7)	205 (47.2)

Dogs were categorized on the basis of AKC group and breed. Numbers are provided for each AKC group as a whole as well as for the most common 2 or 3 breeds within each AKC group. Numbers for purebred dogs of breeds not classified to an AKC group and mixed-breed dogs are reported separately.

*Includes Aruban Cunucu (n = 2), Australian Working Kelpie (1), Dutch Shepherd (1), Linden Coonhound (1), and Maremma (1).

— = Not applicable.

See Table 1 for remainder key.

Table 3—Pair-level descriptive data for the dogs of Table 1.

Variable	Category	All 305 IDA pairs	217 IDA pairs included in outcome analyses
Sex distribution in pair	FF	97 (31.8)	62 (28.6)
	MF	117 (38.4)	89 (41.0)
	MM	91 (29.8)	66 (30.4)
Genetically related	Parent-offspring	5 (1.6)	4 (1.8)
	Littermates	15 (4.9)	10 (4.6)
	Cousins	3 (1.0)	2 (0.9)
Both dogs of same breed	—	95 (31.1)	71 (32.7)
At least 1 dog with brachycephalic phenotype	—	93 (30.5)	62 (28.6)
Both dogs classified as aggressors	—	36 (11.8)	26 (12.0)
AR status switched within pair*	—	15 (4.9)	11 (5.1)
Dogs absent during initial behavioral consultation	—	121 (39.7)	90 (41.5)
Aggression initiated as soon as recipient comes into sight of the aggressor	—	19 (6.2)	13 (6.0)

Values represent number (percentage) of IDA pairs.

*Aggressor became recipient and vice versa. — = Not applicable.

See Table 1 for remainder of key.

had to be kept muzzled when they were together and supervised.

Of the 217 IDA pairs with known outcomes that were included in outcome analyses, 55 (25.3%) had a poor outcome owing to the dogs having to be kept completely separate at all times (n = 23) or rehoming (8) or euthanasia (24) of at least one of the dogs because of behavioral reasons. For the remaining 162 IDA pairs that were included in the outcome analyses, 100 never had to be kept separated following the behavioral intervention, whereas 32 had to be kept

separated during triggers, 21 had to be kept separated when they were unsupervised and during triggers, and 9 had to be kept muzzled when they were together and supervised.

Factors associated with IDA and behavioral intervention outcome

Within IDA pairs, aggressors were generally younger than recipients by a mean of 16 months. When the age difference between dogs of each IDA pair was categorized into 3 categories, the propor-

Table 4—Summary of aggression triggers for the dogs of Table 1.

Trigger	217 IDA pairs included in outcome analyses	
	All 305 IDA pairs	
Resource guarding	222 (72.8)	163 (75.1)
Arousal and excitement	108 (35.4)	73 (33.6)
Uncontrolled and unidentified or unknown	42 (13.8)	26 (12.0)
Uncontrolled and unavoidable*	27 (8.9)	19 (8.8)
Owner proximity and attention	65 (21.3)	48 (22.1)
Confined space	57 (18.7)	38 (17.5)
Other†	24 (7.9)	17 (7.8)
Return of one of the dogs of an IDA pair after an absence	7 (2.3)	6 (2.8)

Values represent the number (percentage) of IDA pairs. Some pairs had multiple aggression triggers. *Includes actions of a blind and deaf dog, as well as vomiting, regurgitation, sneezing, and jumping by the other dog. †Includes behavior changes associated with the estrus cycle, vocal punishment, changes to routine, predation, lack of social signaling from the other dog, going for a walk, being jumped on by the other dog, or the other dog running in a circle.

See Table 1 for remainder of key.

Table 5—Summary of comorbid diagnoses for the dogs of Table 1.

Diagnosis	Category	All 305 IDA pairs		217 IDA pairs included in outcome analyses	
		No. of dogs in category	No. (%) of dogs with the diagnosis	No. of dogs in category	No. (%) of dogs with the diagnosis
Separation anxiety	All dogs	610	76 (12.5)	434	58 (13.4)
	Aggressors	341	50 (14.7)	243	39 (16.0)
	Recipients	269	26 (9.7)	191	19 (9.9)
Fear of confinement	All dogs	610	52 (8.5)	434	36 (8.3)
	Aggressors	341	38 (11.1)	243	26 (10.7)
	Recipients	269	14 (5.2)	191	10 (5.2)
Aggression toward unfamiliar dogs	All dogs	610	122 (20.0)	434	90 (20.7)
	Aggressors	341	101 (29.6)	243	73 (30.0)
	Recipients	269	21 (7.8)	191	17 (8.9)
Aggression toward unfamiliar people	All dogs	610	127 (20.8)	434	97 (22.4)
	Aggressors	341	96 (28.2)	243	77 (31.7)
	Recipients	269	31 (11.5)	191	23 (12.0)
Aggression toward owners	All dogs	610	105 (17.2)	434	74 (17.1)
	Aggressors	341	86 (25.2)	243	59 (24.3)
	Recipients	269	19 (7.1)	191	15 (7.9)
Fear of unfamiliar dogs	All dogs	610	8 (1.3)	434	2 (0.5)
	Aggressors	341	4 (1.2)	243	0 (0)
	Recipients	269	4 (1.5)	191	2 (1.0)
Fear of unfamiliar people	All dogs	610	9 (1.5)	434	6 (1.4)
	Aggressors	341	7 (2.1)	243	5 (2.1)
	Recipients	269	2 (0.7)	191	1 (0.5)
Generalized anxiety	All dogs	610	105 (17.2)	434	92 (21.2)
	Aggressors	341	78 (22.9)	243	69 (28.4)
	Recipients	269	27 (10)	191	23 (12.0)
Global fear	All dogs	610	8 (1.3)	434	8 (1.8)
	Aggressors	341	6 (1.8)	243	6 (2.5)
	Recipients	269	2 (0.7)	191	2 (1.0)
Noise phobia*	All dogs	610	123 (20.2)	434	97 (22.4)
	Aggressors	341	97 (28.4)	243	78 (32.1)
	Recipients	269	26 (9.7)	191	19 (9.9)
Possessive aggression	All dogs	610	216 (35.4)	434	160 (36.9)
	Aggressors	341	195 (57.2)	243	143 (58.8)
	Recipients	269	21 (7.8)	191	17 (8.9)

*Includes fear of sounds associated with thunder, fireworks, gunshots, beeping, and separation of 2 pieces of self-fastening nylon fabric.^c

tion of pairs with a poor outcome did not differ significantly ($P = 0.09$) among pairs in which the aggressor was older than the recipient (14/69 [20.3%]), the aggressor was 0 to 23 months younger than the recipient (8/44 [18.2%]), and the aggressor was > 23 months younger than the recipient (26/78 [33.3%]). The mean \pm SD body weight of aggressors (22.6 \pm

13.2 kg [49.7 \pm 29.7 lb]) was significantly ($P = 0.05$) greater than that of recipients (21.7 \pm 13.5 kg [47.7 \pm 29.7 lb]) by a mean of 1.5 kg (3.3 lb). The AR status was significantly ($P = 0.007$) associated with acquisition order; the aggressor was acquired after the recipient in the majority (125/211 [59.2%]) of IDA pairs evaluated.

A brachycephalic phenotype was not significantly ($P = 0.40$) associated with a poor outcome. The probability of a poor outcome was significantly greater for FF (OR, 2.9; 95% CI, 1.4 to 6.4; $P = 0.006$) and MM (OR, 2.2; 95% CI, 1.0 to 4.7; $P = 0.05$) pairs, compared with that for MF pairs. However, the likelihood of a poor outcome did not differ significantly ($P = 0.40$) between FF and MM pairs.

Among all 305 IDA pairs evaluated, the frequency of fights (as reported by the owners during the initial behavioral consultation) was unpredictable or sporadic for 8 (2.6%), less than monthly for 76 (24.9%), multiple times monthly for 104 (34.1%), daily for 83 (27.2%), and multiple times daily for 28 (9.2%); inadequate data were available to classify 6 (2.0%) of the pairs. Following the behavioral intervention, 123 of the 217 (56.7%) IDA pairs included in the outcome analyses had a fight frequency of less than monthly, which was an improvement from the fight frequency reported at the initial consultation for 69 (31.8%) pairs. Of the remaining IDA pairs included in the outcome analyses, the fight frequency following the behavioral intervention was unpredictable or sporadic for 1 (0.5%), multiple times monthly for 31 (14.3%), daily for 6 (2.8%), and multiple times daily for 2 (0.9%). The owners of 7 (3.2%) pairs felt that they could not accurately predict fights or fight frequency following the behavioral intervention, whereas 1 of the dogs had died or was euthanized for 47 of the 217 (21.7%) pairs with a known outcome.

Of the 610 dogs evaluated, 326 (53.4%) had bitten the other dog in its IDA pair. Bites between dogs were recorded for 110 of the 217 (50.7%) IDA pairs included in the outcome analyses. A poor outcome was 2.5 times as likely for IDA pairs with a maximum bite score ≥ 3 , compared with IDA pairs with a maximum bite score < 3 (OR, 2.5; 95% CI, 1.3 to 4.8; $P = 0.005$).

The aggressor reportedly initiated fights on sight of the recipient (aggression on sight) for 13 of the 217 (6.0%) IDA pairs included in the outcome analyses. A poor outcome was reported for 8 of the 13 (61.5%) pairs with aggression on sight, compared with only 47 of the 204 (23%) pairs that did not report aggression on sight. Thus, the probability of a poor outcome for IDA pairs with aggression displayed on sight of the recipient was approximately 5 times that for IDA pairs without aggression on sight (OR, 5.3; 95% CI, 1.7 to 17.1; $P = 0.005$). Nineteen (8.8%) and 26 (12.0%) of the 217 IDA pairs included in the outcome analyses had unavoidable and unknown fight triggers, respectively. However, unavoidable ($P = 0.20$) and unknown ($P = 0.10$) triggers were not significantly associated with a poor outcome. A poor outcome was also not significantly associated with dogs of the same breed ($P = 0.70$), defensive aggression by the recipient ($P = 0.20$), absence of at least 1 of the dogs during the initial behavioral consultation ($P = 0.70$), or diagnosis of separation anxiety ($P = 0.60$) or fear of confinement ($P = 0.90$) as a comorbidity.

Discussion

The purpose of the present study was to characterize intrahousehold IDA and identify dog and pair factors associated with IDA that lead to a poor outcome, which was defined as complete separation of the involved dogs or rehoming or euthanasia of 1 or both dogs. Results of the present study indicated that the majority (214/305 [70%]) of dog pairs involved in IDA (IDA pairs) included at least 1 female dog, and most IDA pairs involved dogs of the same sex. Resource guarding was the most common fight trigger for the IDA pairs (222/305 [72.8%]). Possessive aggression was the most commonly diagnosed comorbidity for individual dogs (216/610 [35.4%]) evaluated in the present study. Aggressors tended to be younger and heavier than recipients and were often introduced into the household after recipients. Factors associated with a poor outcome for IDA pairs included aggression on sight (ie, uninhibited attacks), the occurrence of bites that broke the skin, and pairs involving dogs of the same sex (same-sex pairs).

Results of other studies^{2,3,9,11,33,a} likewise indicate that intrahousehold IDA frequently involves dogs of the same sex. However, to our knowledge, the present study was the first to find an association between same-sex pairs and the likelihood of a poor outcome. In the present study, FF and MM pairs were 2.9 and 2.2 times as likely to have a poor outcome, respectively, compared with MF pairs. Aggression between dogs of FF pairs might be more intense than aggression between dogs of MM and MF pairs owing to a hypothesized female hierarchy, which is independent of environment and develops in female dogs at some point after 2 months of age.²³ Parallel all-male and all-female hierarchies have been observed within wolf packs.²³ Domestic dogs are not wolves, but aggression between 2 animals of the same sex might be a vestige of the social hierarchy passed down from the common ancestral species from which both dogs and wolves evolved. The finding regarding same-sex dog pairs and IDA was important because that information can be used during preadoption counseling for pet owners who are looking to add a second dog to their household. Historically, the addition of a second female dog to a household has been discouraged,³³ likely owing to the high frequency of females in IDA pairs. The present study did not include a control group (pairs of dogs from the same household that coexisted without IDA) to validate that recommendation; however, results indicated that when IDA was present, same-sex pairs, particularly FF pairs, had a poor prognosis. Therefore, it appears prudent to recommend that the second dog introduced into a household should be of the opposite sex to the existing dog in the household. Additionally, early referral to a veterinary behaviorist should be recommended for IDA pairs of the same sex because of the high risk of a poor outcome for such pairs.

In physical conflicts, the physical characteristics of the individuals involved are important factors because they can affect the outcome, particularly when those characteristics mechanically alter or improve performance during a fight. That is especially true when there are substantial differences in size between combatants. The present study was the first to evaluate body weight of dogs involved in IDA pairs, and results indicated that the mean body weight of aggressors was 1.5 kg greater than that of recipients. Further research is necessary to determine whether a substantial difference in body weight between dogs has a causal role in IDA, but weight difference is an important consideration during preadoption counseling.

In the majority (181/305 [59.3%]) of IDA pairs evaluated in the present study, the aggressor was introduced into the household after the recipient. This was similar to results of another study³ in which the aggressor was introduced to the household after the recipient in 58 of 99 (59%) IDA pairs. Newly introduced dogs in a household might become aggressive in an attempt to improve their rank within the new social hierarchy.^{20,23} The association between acquisition order and AR status may help veterinary clinicians and behaviorists determine the AR status of dogs within IDA pairs when it is not readily apparent, such as for pairs in which the recipient displays substantial defensive aggression. Further research into the association between acquisition order of dogs and IDA is necessary.

In the present study, aggressors were generally younger than recipients by a mean of 16 months, and results of the logistic regression analysis suggested that IDA pairs in which the aggressor was ≥ 2 years younger than the recipient were twice as likely to have a poor outcome, compared with IDA pairs in which the aggressor was older than the recipient, although that comparison did not quite reach our cutoff for significance ($P = 0.08$). Similarly, the aggressor was younger than the recipient in 88% of IDA pairs evaluated in another study.^a In yet another study,²⁹ aggression between dogs within the same household was positively associated with age, but the difference in age between the dogs involved in conflicts was not evaluated. Results of 1 study³ indicate that the aggressive behavior of aggressors is less likely to improve when the aggressor is younger than the recipient, compared to when the aggressor is approximately the same age as or older than the recipient. The investigators of that study³ also reported that the outcome for IDA pairs was negatively associated with the age difference between the involved dogs. Collectively, results of the present study and those other studies^{3,29,a} suggested that the magnitude of the age difference may have an important role in IDA and be predictive of its outcome. Thus, the age difference between 2 dogs should be considered during preadoption counseling. Other factors that require further research and should be considered during preadoption counseling include biologically based differences in maturation, such as whether the dogs under

consideration have reached social maturity or whether 1 of the dogs will be introduced into the household during its socialization period.

Results of the present study also indicated that IDA pairs in which bites that broke the skin occurred were more likely to have a poor outcome than were IDA pairs in which bites that broke the skin did not occur (ie, fight severity was positively associated with the risk of a poor outcome). That finding was similar to results of 1 study^{3,4} but contrary to results of another study³ in which fight intensity was not associated with IDA outcome. In the present study, fight severity was scored on the basis of the most severe injury observed by the owner before or after the initial behavioral consultation. The dog bite scoring system used was easily applied to information obtained from owners as well as that gained from visual inspection of wounds by an attending clinician.² Use of dog bite scores and evaluation of wounds for breaches in skin integrity can provide valuable prognostic data for IDA outcome and can be easily performed by general practitioners, emergency veterinarians, and veterinary behaviorists. It may also facilitate early identification of IDA severity and guide subsequent intervention, including referral to a veterinary behaviorist, which could improve outcome.

A novel finding of the present study was the association between aggression on sight of the recipient (uninhibited attack) and a poor outcome. Aggression on sight is difficult to manage in the home because the dogs need to be kept completely separate and out of sight of one another and the barriers between the dogs need to be absolutely secure as well as nonvisual. Researchers of another study³ failed to find an association between complete separation of IDA pairs prior to the first appointment and outcome; however, the separated IDA pairs of that study likely included those without aggression on sight but were not exclusive to them. In the present study, aggression on sight was specifically assessed as a factor that contributed to complete separation of the dogs, and it was hypothesized that IDA pairs with aggression on sight of the recipient would have a poor outcome. Aggression on sight of the recipient was easy to identify on the basis of owner-provided history and observation when both dogs were present. When aggression on sight is present, it provides important prognostic information for discussion with the owner and might expedite referral to a veterinary behaviorist. Freedom from fear and distress is 1 of the 5 freedoms associated with good animal welfare.²⁷ Successful management of IDA requires that both the aggressor and recipient be protected from physical injury as well as fear. Thus, corrective intervention of aggression on sight is important for reasons beyond simple prognosis.

A brachycephalic phenotype was not associated with a poor outcome for the IDA pairs of the present study. That was a notable finding because poor signaling between dogs has been proposed as a contributing factor to the development of intrahousehold

IDA,^{9,23,26} even though there is currently no evidence to support that hypothesis. Additional research is necessary to determine whether specific factors, such as docked tails, cropped or drooping ears, and facial wrinkles, affect the ability of dogs to properly signal information to other dogs. It is possible dogs that have cohabited for a prolonged period may signal less frequently than dogs that have been recently introduced to one another, as has been observed in studies of dominance-subordinate posturing among dogs of the same breed.²³ Thus, phenotypic variations may not be influential in interdog communication and signaling.

Comorbid diagnoses of separation anxiety and fear of confinement were not associated with a poor outcome for the IDA pairs of the present study. That finding was important from a management standpoint because many IDA pairs have to be separated or confined as part of the prescribed behavioral intervention. The fact that separation anxiety and fear of confinement was not associated with a poor outcome should provide owners of dogs with those conditions hope that the IDA can be successfully managed, despite the fact that affected dogs may have to be segregated from each other and possibly from the people in the home at times.

Triggers for aggression were frequently unavoidable (42/305 [13.8%]) or unknown (69/305 [22.6%]) for the IDA pairs of the present study, but unavoidable or unknown triggers were not significantly associated with a poor outcome. This was surprising because those types of triggers were associated with a poor outcome for IDA pairs of another study³ and behavior-related euthanasia for dogs of yet another study.³⁴ Unavoidable and unknown triggers make prediction of aggressive episodes difficult. In regard to the present study, it is possible that households in which unavoidable or unknown triggers contributed to IDA implemented more preventative measures to reduce fight frequency and severity, thereby minimizing the effect of those triggers on IDA outcome.

In the present study, outcome analyses involved only those IDA pairs in which at least one of the dogs was euthanized for behavioral reasons or for which there was at least 6 months of follow-up information available. This was done to ensure that IDA pairs were provided an adequate duration of evaluation following implementation of behavioral intervention to avoid biased outcome results. In our clinical experience, the outcomes for most IDA pairs will be realized within 6 months after implementation of behavioral intervention. Restriction of the IDA pairs eligible for inclusion in the outcome analyses reduced the sample size for those analyses; however, given that the demographics (eg, sex, reproductive status, age at initial behavioral consultation, age at acquisition, and presence of defensive aggression and aggression on sight within the IDA pair) for the 217 IDA pairs included in the outcome analyses were similar to those for all 305 IDA pairs evaluated, we believe that the re-

sults regarding IDA outcome would not have changed noticeably had data for all 305 pairs been included in the analyses.

The present study had several limitations. Because the study was retrospective in nature, the specific methods used to obtain data at the time of patient (IDA pair) care and treatment could not be standardized. Approaches used to minimize potential biases and other errors included the development of clear descriptive data categories prior to medical records review and use of a uniform tool to extract data from patient medical records by an individual who was uninvolved with patient treatment and who had no knowledge of the study hypotheses. Prospective studies in which interrater-validated aggression rating scales are used to assess bites, evaluate defensive aggression by the recipient, and determine AR status are necessary to affirm the usefulness of the prognostic factors identified in this study. Also, additional factors that might contribute to IDA pair prognosis, such as household factors (eg, presence of children, number of people living in the home, and size of home), owner-related factors (eg, age and time available for management of IDA), or IDA pair factors (eg, duration between introduction of a new dog into the home and onset of IDA) were not considered in this study. The type of follow-up with the attending veterinarian was also not evaluated in this study and might have an effect on outcome. Future studies of IDA pairs should include evaluation of the type and quantity of follow-up care provided for each pair to assess whether those factors are relevant to the outcome. Although the present study involved one of the largest populations of intrahousehold IDA pairs evaluated to date, some factors such as presence of aggression on sight and familial ties were uncommon, which may have resulted in unstable estimates and led to type I or II errors. Environment can affect the behavior of dogs. All IDA pairs evaluated in this study were maintained in different households; therefore, the environment was not standardized. Finally, all IDA pairs included in this study were from 1 referral veterinary practice limited to evaluation of pets for behavioral problems at 1 location and evaluated by 1 veterinarian. So, although the results were likely valid for this population and veterinarian, they may not be generalizable to other populations or veterinary clinics. Generalizability would have been improved had data been obtained from multiple veterinary behavior clinics from many areas of the country.

Results of the present study indicated that IDA pairs in which both dogs were of the same sex and that had a history of bites that broke the skin or aggression on sight of the recipient were at risk of a poor outcome (permanent separation, rehoming, or euthanasia of dogs). Identification of those risk factors can expedite and facilitate development of a behavioral intervention. That information can also be used to help owners assess the likelihood of a positive outcome for IDA between their pets. Owners of IDA pairs are keenly interested in ascertaining whether that behavior can be changed and view consultation

with a veterinary behaviorist as a last resort, with rehoming and euthanasia commonly discussed and considered. The provision of accurate prognostic information to owners of IDA pairs is critical because it may mean life or death for the involved dogs and protect families from undue stress and loss of valuable resources. Results of this study can also be used to facilitate preadoption counseling. Results of the present study also suggested that addition of a second dog to a household should be carefully considered and planned so that the 2 dogs are of the opposite sex and are of similar age and body weight. Further prospective studies are necessary to determine whether the risk of intrahousehold IDA can be reduced through the maintenance of pairs of dogs of the opposite sex, pairs in which the age difference is < 2 years, and pairs in which the female is acquired before the male.

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Footnotes

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- Stata, version 12.1, StataCorp LP, College Station, Tex.
- Velcro fastener, Velcro Co, London, England.

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Appendix

Scoring system used to assess the most severe bite observed between dogs of IDA pairs that were evaluated and treated for intra-household IDA by 1 referral veterinary behavioral practice between September 2007 and September 2016.

Score	Description
1	Growling, lunging, or snarling behavior occurred without teeth touching skin (ie, mostly intimidation behavior).
2	Teeth touched skin, but no puncture wounds were inflicted. Marks or minor scratches from paws and nails (minor surface abrasions) may have been incurred.
3	Punctures were half the length of a canine tooth and resulted in 1–4 holes from a single bite. No tears or slashes were incurred, and the recipient was not shaken side to side.
4	One to 4 holes from a single bite, with 1 or more holes deeper than half the length of a canine tooth. Contact and punctures were incurred from more than the canine teeth. Tears, slash wounds, or both resulted. One dog clamped its teeth down and the other dog was shaken or slashed.
5	Multiple bites at severity level 4 or greater incurred in a concerted, repeated attack.
6	Any bite that resulted in death of a dog.

The same system was used to assign bite scores to individual dogs with a minor modification; recipients that did not fight back were assigned a bite score of 0. (From Wrubel KM, Moon-Fanelli AA, Maranda LS, et al. Interdog household aggression: 38 cases [2006–2007]. *J Am Vet Med Assoc* 2011;238:731–740. Reprinted with permission.)



From this month's AJVR

Effects of treatment with lispro and neutral protamine Hagedorn insulins on serum fructosamine and postprandial blood glucose concentrations in dogs with clinically well-controlled diabetes mellitus and postprandial hyperglycemia

Abigail V. Bertalan et al

OBJECTIVE

To assess effects of basal-bolus insulin treatment (BBIT) with lispro and neutral protamine Hagedorn (NPH) insulins, compared with NPH insulin alone, on serum fructosamine concentration (SFC) and postprandial blood glucose concentration (BGC) in dogs with clinically well-controlled diabetes mellitus and postprandial hyperglycemia fed a high insoluble fiber-content diet.

ANIMALS

6 client-owned dogs with diabetes mellitus.

PROCEDURES

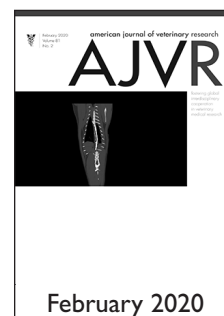
Blood was collected for BGC and SFC measurement in hospitalized dogs just before feeding and routine SC NPH insulin administration (time 0); samples were collected for BGC measurement every 30 minutes for 2 hours, then every 2 hours for up to 10 additional hours. Postprandial hyperglycemia was identified when BGC 30 minutes after insulin administration exceeded BGC at time 0 or the 1-hour time point. For BBIT, owners were instructed to continue NPH insulin administration at the usual dosage at home (q 12 h, with feeding) and to administer lispro insulin (0.1 U/Kg, SC) separately at the time of NPH injections. Two weeks later, SFC and BGC measurements were repeated; results at the start and end of the study were compared statistically.

RESULTS

Median SFC was significantly higher at the start (400 $\mu\text{mol/L}$) than at the end (390 $\mu\text{mol/L}$) of the study. Median 1-hour (313 mg/dL) and 1.5-hour (239 mg/dL) BGC measurements at the start of the study were significantly higher than those at the end of the study (117 and 94 mg/dL, respectively).

CONCLUSIONS AND CLINICAL RELEVANCE

In this sample of dogs with well-controlled diabetes mellitus, addition of lispro insulin to an existing treatment regimen of NPH insulin and dietary management significantly decreased postprandial BGCs. Further study of BBIT for dogs with diabetes mellitus is warranted. (*Am J Vet Res* 2020;81:153–158)



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