

Study of fear and fear evoking stimuli in a population of domestic dogs in Iran: a questionnaire-based study

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Summary

General and social acceptance, condition, and rules for dog ownership in Iran are different from western countries. This phenomenon leads to dissimilar fear and fear evoking stimuli in dogs. Stress and fear-related factors and dog's behavioral problems are not fully studied in Iran. Thus, the aim of the current study was to measuring fear-related factors in dogs in Iran. In the first part of this study, demographic information of the owners and dogs was collected using questionnaire from clinics and veterinary hospitals in Tehran. In the second part, behavioral tests were conducted. Questionnaire data were recorded based on 4 items as neuroticism, fear caused by other dogs, fear caused by human and separation behavior. The social contact test was used to determine dog's experience for greeting, cooperation, and handling. According to the results, 69.3% of the dog owners were women and 30.7% men. 84.1% of the dogs were small breed and 15.9% large-breed dogs. 63.6% of the owner's complained for impact of laws and prohibitions on their dogs' access to outdoor. The score for greeting, cooperation and handling were 1.76 ± 0.93 , 3.06 ± 1.25 and 2.44 ± 1.21 , respectively. Mean score for neuroticism, fear caused by other dogs, fear caused by human and separation behavior were 29.69 ± 9.24 , 14.75 ± 5.38 , 9.84 ± 4.05 and 6.57 ± 3.05 , respectively. Principal component analysis (PCA) revealed that fear using neuroticism, fear caused by other dogs and human were 1st fear related factor while separation-related behavior was the 2nd priority ($P = 0.001$). Small-breed dogs had more separation behavior and fear caused by other dogs compared to the large-breed dogs ($P = 0.001$). These findings suggested keeping the dogs indoor with limit access to a yard had negative impact on dog's behaviors. Legal restrictions have adverse effect on fear behavior in dogs. Determination of fear-related factors might prove useful for dog's behavioral intervention in Iran.

Introduction

Dogs that experience fear in response to everyday stimuli are likely to have reduced welfare and are at a higher risk for the development of behavior problems (Stellato *et al.* 2017). Behavioral problems describe as unusual and unacceptable behaviors exhibited by dogs. Behavior problems are common among dogs adopted from animal shelters. Behavioral problems of untreated dogs lead to pathophysiological conditions such as infection, neoplasia, metabolic diseases and even death

(Tamimi *et al.* 2013). Several research has been done to determine the individual behavior of dogs in a wide range of contexts (Temesi *et al.* 2014). To assess canine personality and behavior, Jones and Gosling (Jones and Gosling 2005) identified seven broad categories called 'temperament dimensions' which categorized as activity, sociability, reactivity, responsiveness to training, submissiveness, aggression and fear-fullness (Fratkin *et al.* 2013). Fear is known as cognitive and emotional state which directly activates defensive behaviors in response to threatening and/or painful stimuli and can impair

dog welfare (Flint *et al.* 2018). Fear-related factors in dogs can be separated into intrinsic and extrinsic variables. The main intrinsic variables are dog's breed, age, sex and neutering status (Blackwell *et al.* 2013). Extrinsic or environmental factors are owners' characteristics, keeping condition, interaction with the owner, training experience and hours spent with the dog (Flint *et al.* 2018). If owners do not recognize fear, it can cause other behavioral problems, such as aggression which threatens human safety (Flint *et al.* 2018). Undesirable behaviors are common in the domestic dog population (Cannas *et al.* 2018). Domestic dogs are highly social animals and relationship between conspecifics is integral part of their environment. It has been supposed that more than 30% of owners relinquished their dogs to shelters due to behavioral problems. The majority of dogs, purchased from these shelters, were also returned because of behavioral problems (Tamimi *et al.* 2013). The most commonly reported behavioral problems of dogs relinquished to animal shelters are fearfulness, aggression, destructiveness, inappropriate elimination and straying (Wells and Hepper 2000). The existence of fear decreases the quality of life in dog and may reflect an inappropriate environment. Research on social behavior in domestic dog population mostly focused on reproductive behaviors, negative social behaviors or lack of social behavior such as social separation and isolation (Normando *et al.* 2019). In general practice, it is hard to evaluate behavioral problems unless they are based on a behavioral diagnostic protocol (Tamimi *et al.* 2013). To properly investigate the causes and consequences of canine fear, it is important to correctly identify affected individuals (Stellato *et al.* 2017).

Standardized questionnaires are thought to be good tools for this purpose if their reliability has been validated. Several questionnaires have been developed for measuring fearfulness in dogs by obtaining information from dog owners (Flint *et al.* 2018). Although numerous studies and texts have been published in the United States and Europe regarding canine behavioral problems, few studies have been published in the Middle East, including Iran. Until now, three questionnaires-based surveys have been conducted on dogs in Iran in which undesirable behaviors were reported by owners (Khoshnegah *et al.* 2011, Tamimi *et al.* 2013, Tamimi *et al.* 2014). Dog ownership is a relatively new phenomenon for most inexperienced Iranian people. There are growing interest for dog ownership among Iranian families as well as for those people who live alone and want to keep dog. Restrictive government rules, forbidding any public appearance of dogs, have adversely affected dog ownership (Tamimi *et al.* 2014). Despite people's willingness to own dogs, a lack of knowledge of their physiological and

behavioral needs leads to dogs being kept in an uncomfortable condition. In addition, due to different cultures, it seems that fear-related factors may be different from developed countries. Also, because of different cultures, it seems fear-related factors might be different from developed countries. The advantage of determining stress- and fear-related factors of dogs in these societies can improve general knowledge and minimize fear-related factors. So, the first purpose of this study was to assess stress-related factors including neuroticism, fear caused by other dogs, fear caused by human and separation behavior among dog's population in Iran. Also, the second goal was to determine difficulties for keeping dogs at home in Iran.

Materials and methods

Subjects

Dog owners were asked to fill out questionnaire which was advertised in pet clinics in Tehran, Iran, during 2019. Information about the study was given on posters in the clinic waiting room. In addition, popular social networking services were used to recruit owners for this project. The target population was privately owned dog patients in the Tehran city. All experimental procedure were approved by Department of Basic Sciences, Faculty of Veterinary Medicine, Razi University, Kermanshah, Iran. All participants were informed about the study and after agreement, they were included in the study. The questionnaire data were recorded from 176 participants. Demographic information of the owners and dogs is provided in Tables I and II.

Questionnaire design

The living condition, society culture, religious beliefs and rules in Islamic countries lead to a different situation for keeping pet than western countries. Therefore, the stress-related factors to be identified are quite different. Hence, in the current study we used a questionnaire based on 4 items including neuroticism, fear caused by other dogs, fear caused by humans and separation behavior, according to the previous questionnaire (Tamimi *et al.* 2014, Temesi *et al.* 2014). Several behavioral indicators of fear in dogs have been discussed in the literature, including key behaviors that are associated with the main strategies described above, such as reduced posture/cowering, freezing, avoidance and escape attempts, as well as subtle behavioral indicators of fear (Stellato *et al.* 2017). There were different factors from other reports, which contain items with remarkably similar meaning and phrasing. In this study, "fear caused by other dogs" was used for

fear when a dog faces with another dog, and “fear caused by human” was used for fear when a dog faces with a stranger. Because of frequency of the items to determine fear related factors and to avoid duplicates, the most impressive items were included. The final questionnaire included 24 behavioral questions and focused on basic information such as owner’s and dog’s age, sex, breed, outdoor walking schedule and habits of interaction with other people than family members and animal’s access to yard. The neuroticism section included 11 questions, fear caused by other dogs had 6 questions, fear caused by human was composed of 4 questions and separation behavior had 3 questions (Table IX). For categorization of the answers, 5-point frequency scale (1 = never, 2 = seldom, 3 = sometimes, 4 = usually, 5 = always) was used (Tamimi *et al.* 2014, Temesi *et al.* 2014). The owners were interviewed and guided while filling out the questionnaires. In addition, Tamimi and colleagues (Tamimi *et al.* 2014), reported that it would be helpful if the next research determined the difficulties in keeping a pet at home in Iran compared to Western society, as these could be traced to factors related to fear in this society. So, we provided 3 questions as: “Impact of rules and prohibitions on access of dog to outdoor”, “Are family members satisfied with keeping the dog at home?” and “Do neighbours complain about keeping dogs?”, to conclude possible impact of condition on stress-related factors (Table I).

Behavior tests

The test was done when the patient was in the waiting room before the veterinary consultation and after the owner had filled in the questionnaire and owner approval form, to insure that the answers were not affected by the behavioral tests and veterinarian consultation. The social contact test was used to determine dog’s experience. The test was done in 3 subtests as greeting, cooperation, and handling (Svartberg and Forkman 2002).

In the greeting test, the dog greeted the owner and shake his/her hand, after which he/she greeted the dog, by kneeling beside the dog and petting it on the side and chest for 30 seconds. The score given for contact with refusal or growling and/or bite attempts is (I), up to the greeting with intense contact to the test leader where the dog may jump and whine (V) (Svartberg and Forkman 2002, Lind *et al.* 2017). The cooperation test was used to determine the willingness of a dog to a stranger (test leader). The test leader took the leash and walked 15-20 meters away from the owner with dog, then paused for 5 seconds before returning to the owner. Test lasted for 1-2 minutes and scored as (I) refuses to walk with a stranger to (V) eager to walk with stranger and intense greeting toward stranger,

with jumping and whining (Svartberg and Forkman 2002, Lind *et al.* 2017). After returning to the owner, handling test, body and chest of the dog physically touched before opening its mouth for looking at the teeth. The handling score was (1) rejects handling, with growl and/or biting attempts to (5) accepts handling with intense social behavior toward the test leader (Svartberg and Forkman 2002; Lind *et al.* 2017).

Data collection and analysis

Generalized linear models (GLMs) with backward elimination (limited to two-way interactions) were run separately for the traits obtained after the principal component analysis (PCA) as well as for each published questionnaire trait if the Cronbach’s alpha value was acceptable (Cronbach’s alpha > 0.60). The Pearson χ^2 , g, Kendall rank correlation coefficient and Spearman correlation tests were used to evaluate the relationship between presence of the behavioral complaint and age, sex, breed of dogs, walking schedule, interaction with other animals and humans, owner’s reaction toward the behavior and access to a yard. For the PCA, the Varimax method use for rotation and threshold for valuable loading was determined at level of 5%. The statistical analyses were computed using SPSS 22.0 for Windows (SPSS, Inc., Chicago, IL).

Results

The demographic information of owners included in the study is shown in Table I. As seen, 30.7% were men and 69.3% were women. The 56.8% were older than 30 years and 42.6% had 20-30 years old. 55.7% of the owner’s spent more than 4 hours per day with their dog and only 5.7% spent less than an hour/day. Based on the owner’s response, 63.6% of them confirmed the rules and prohibitions have a high impact on dog’s access to outdoor. In 81.8%, there was no complaints of neighbors for keeping dogs (Table I).

Based on Table II, 84.1% of the dogs were small breeds and 15.9% were large breeds. 57.4% of the dogs were 1-3 years old and 15.3% had more than 7 years old. In 76.1%, acquisition was done at < 6 months. 55.7% of the dogs spent more than 4 hours outdoor per day and just 5.7% had less than an hour access to yard. Also, 80.7% of the dogs have been trained which 73.9% of them responded to the “sit” command and 48.9% responded to the “stay” command.

The frequency of the score for behavioral tests and fear-related factors is presented in Table III. The score for greeting, cooperation and handling was 1.76 ± 0.93 , 3.06 ± 1.25 and 2.44 ± 1.21 , respectively.

Table I. The demographic information of the owners included in the study (n = 176).

Characteristics	Categories
Gender	Man (n = 54), 30.7%
	Woman (n = 122), 69.3%
Age	< 20 years old (n = 1), 0.6%
	20-30 years old (n = 75), 42.6%
	> 30 years old (n = 100), 56.8%
	< 1 (n = 10), 5.7%
Hours spent with the dog (per day, on average)	1-2 (n = 20), 11.4%
	2-4 (n = 48), 27.3%
	> 4 (n = 98), 55.7%
Impact of laws and prohibitions on dogs' access to outdoor	No effect (n = 14), 8%
	Low (n = 50), 24.8%
	High (n = 112), 63.6%
Are family members satisfied with dog keeping at home?	Yes (n = 172), 97.7%
	No (n = 4), 2.3%
Do neighbors complain about dog keeping?	Yes (n = 32), 18.2%
	No (n = 144), 81.8%

The score for neuroticism, fear caused by other dogs, fear caused by human and separation behavior were 29.69 ± 9.24 , 14.75 ± 5.38 , 9.84 ± 4.05 and 6.57 ± 3.05 , respectively.

According to the results, a significant positive correlation was observed between greeting with cooperation reaction, handling and neuroticism ($p < 0.001$). Also, a significant positive correlation was seen in cooperation reaction with handling and neuroticism as well as between fear caused by other dogs and fear caused by human ($p < 0.001$) (Table IV). In score of the fear related factors based on the dog's breed category, no significant difference was observed in neuroticism, fear caused by human, fear caused by other dog's factors and separation behavior in small and large breed dogs ($p > 0.05$) (Table V). A significant regression was seen among greeting with separation behavior, neuroticism, fear caused by human and fear caused by other dog's factors ($F = 4.156$; $df:4/45$, $p = 0.001$) and significant regression co-effect of greeting

Table II. The demographic information of the dogs included in the study (n = 176).

Characteristics	Categories
Breed	Large (n = 28), 15.9%
	Small (n = 148), 84.1%
Age	1-3 years old (n = 101), 57.4%
	3-7 years old (n = 48), 27.3%
	> 7 years old (n = 27), 15.3%
	< 1 (n = 10), 5.7%
Sex and neutering status	Male (n = 90), 51.1
	Neutered (n = 58), 64.4%
	Female (n = 86), 48.9
	Neutered (n = 46), 53.5%
Age at acquisition	< 6 months (n = 134), 76.1%
	6-12 months (n = 34), 19.3%
	12 months < (n = 8), 4.5%
Hours of access to yard (per day, on average)	< 1 (n = 84), 47.7%
	1-2 (n = 52), 29.5%
	2-4 (n = 16), 9.1%
	> 4 (n = 24), 13.6%
Hours spent with dog (per day, on average)	< 1 (n = 10), 5.7%
	1-2 (n = 20), 11.4%
	2-4 (n = 48), 27.3%
	> 4 (n = 98), 55.7%
Contact or relation with other dogs	Yes (n = 75), 42.6%
	No (n = 101), 57.4%
Training experience	Trained (n = 142), 80.7%
	Untrained (n = 34), 19.3%
Does the dog respond to the "sit" command?	Yes (n = 130), 73.9%
	No (n = 46), 26.1%
Does the dog respond to the "stay" command?	Yes (n = 86), 48.9%
	No (n = 90), 51.1%

Table III. The score of the behavioral tests and fear-related factors in Iranian dogs.

	N	Mean \pm SD	Minimum	Maximum
Greeting	50	1.76 ± 0.93	1	4
Cooperation reaction	50	3.06 ± 1.25	1	5
Handling	50	2.44 ± 1.21	1	5
Neuroticism	176	29.69 ± 9.24	16	51
Fear caused by other dogs	176	14.75 ± 5.38	5	28
Fear caused by human	176	9.84 ± 4.05	3	20
Separation behavior	176	6.57 ± 3.05	3	15

Table IV. The correlation of the behavioral tests and fear-related factors in Iranian dogs.

	Greeting	Cooperation reaction	Handling	Neuroticism	Fear caused by other dogs	Fear caused by human	Separation behavior
Greeting	1						
Cooperation reaction	0.794**	1					
Handling	0.829**	0.774**	1				
Neuroticism	0.489**	0.594**	0.407**	1			
Fear caused by other dogs	0.314*	0.356*	0.274	0.435**	1		
Fear caused by human	0.254	0.338*	0.249	0.379**	0.961**	1	
Separation behavior	-0.058	0.069	0.107	0.077	0.059	0.114	1

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed); Fear caused by other dogs: fear when a dog face with another dog; Fear caused by human: a fear when a dog face with a stranger.

Table V. The score of the fear-related factors based on the Iranian dog's breed category.

	Size of dog	Mean \pm SD	Max	Min	P-value
Neuroticism	Large	26.92 \pm 8.91	43	16	0.084 ^{ns}
	Small	30.2 \pm 9.23	51	17	
Fear caused by other dogs	Large	13.10 \pm 6.76	27	5	0.154 ^{ns}
	Small	15.06 \pm 5.05	28	6	
Fear caused by human	Large	9.32 \pm 5.01	19	3	0.537 ^{ns}
	Small	9.94 \pm 3.86	20	4	
Separation behavior	Large	5.82 \pm 3.62	14	3	0.153 ^{ns}
	Small	6.72 \pm 2.93	15	3	

Fear caused by other dogs = Fear when a dog face with another dog;
 Fear caused by human = A fear when a dog face with a stranger; ns: non-significant;
 Max = Maximum; Min = Minimum.

with neuroticism ($p = 0.006$) (Table VI). There was a significant regression of co-operation reaction with separation behavior, neuroticism, fear caused by human and other dog's ($F = 6.645$; $df:4/45$, $p = 0.000$) (Table VII). Also, significant regression was detected on handling with separation behavior, neuroticism, fear caused by human and other dog's ($F = 2.652$; $df:4/45$, $p = 0.045$) which significant regression co-effect of handling with neuroticism detected ($p = 0.032$) (Table VIII).

The result of the PCA was shown in Tables IX-XI. The PCA retained 4 factors and 24 questionnaire items which explained a total variance of 73.3%. Factors, interpreted as traits were labelled on the basis of items loading (Table IX): (1) neuroticism (variance = 20.81%, 11 items, Cronbach's Alpha = 0.962); (2) fear caused by other dogs (variance = 19.44%, 6 items, Cronbach's Alpha = 0.932); (3) fear caused by human (variance = 21.48%, 4 items, Cronbach's Alpha = 0.934) and (4) separation-related behavior (variance = 11.57%, 3 items, Cronbach's Alpha = 0.855). Neuroticism as excitement in strange situations or places, a fearful reaction to sudden visual, acoustic stimuli, how cautiously or nervously a dog is perceived to behave (Ley *et al.* 2009). The separation-related behavior was dissimilar from fear (Hsu and Serpell 2003, Hsu and Sun 2010). Social fear was divided into fear caused by human and fear caused by other dogs (similar to Hsu and Serpell 2003). According to Table IX, neuroticism items were mostly affected by neuroticism questions (from the top) number four (0.787) and ten (0.764). Also, fear caused by other dogs was typically affected by questions number one (0.861), two (0.871) and four (0.861). The fear caused by human was mostly affected by questions one (0.914), two (0.833) and three (0.848). Additionally, the separation behavior items were affected by separation behavior questions one (0.93), two (0.926) and three (0.886).

To determine relationship between different aspects

Table VI. The regression co-effect of greeting with fear-related factors in Iranian dogs.

	Regression coefficient	Std. Error	P value
(Constant)	0.142	0.536	0.793 ^{ns}
Neuroticism	0.041	0.014	0.006 ^{**}
Fear caused by other dogs	0.096	0.086	0.268 ^{ns}
Fear caused by human	- 0.103	0.11	0.357 ^{ns}
Separation behavior	- 0.01	0.041	0.811 ^{ns}

Fear caused by other dogs = Fear when a dog face with another dog;
 Fear caused by human = A fear when a dog face with a stranger;
 ** $P < 0.001$; ns = Non-significant.

Table VII. The regression co-effect of cooperation reaction with fear-related factors in Iranian dogs.

	Regression coefficient	Std. Error	P value
(Constant)	0.322	0.663	0.63 ^{ns}
Neuroticism	0.071	0.018	0 ^{ns}
Fear caused by other dogs	- 0.003	0.106	0.979 ^{ns}
Fear caused by human	0.045	0.137	0.744 ^{ns}
Separation behavior	0.025	0.05	0.624 ^{ns}

Fear caused by other dogs = Fear when a dog face with another dog;
 Fear caused by human = A fear when a dog face with a stranger;
 ** $P < 0.001$; ns = Non-significant.

Table VIII. The regression co-effect of handling with fear-related factors in Iranian dogs.

	Regression coefficient	Std. Error	P value
(Constant)	0.301	0.73	0.682 ^{ns}
Neuroticism	0.043	0.019	0.032 ^{**}
Fear caused by other dogs	0.057	0.117	0.629 ^{ns}
Fear caused by human	- 0.035	0.151	0.819 ^{ns}
Separation behavior	0.048	0.055	0.39 ^{ns}

Fear caused by other dogs = Fear when a dog face with another dog;
 Fear caused by human = A fear when a dog face with a stranger;
 ** $P < 0.001$; ns = Non-significant.

of fear, the PCA was done. According to the Table X, the neuroticism, the fear caused by other dogs and human were detected as 1st factor for fear while separation-related behavior was the 2nd factor responsible for fear. The score of the consensus questionnaire with fear-related factors based on the dogs' breed category is presented in Table XI. In neuroticism questions, there was a significant difference in question "dog looks calm in unfamiliar environments" between large and small dogs which small breeds were calmer in unfamiliar environments ($p = 0.022$). Also, there was a significant difference in question "Your dog looks calm in crowded and noisy places" with small breeds being still more calm than large breeds ($p = 0.039$). No significant difference was observed on the other neuroticism questions among large and small breeds ($p > 0.05$).

In fear caused by other dogs, significant difference was observed on question “Dog gets fearfully or anxiously when barked, growled or lunged at by an unfamiliar dog” ($p = 0.005$), “Dog behaves fearfully towards other dogs” ($p = 0.001$), “Dog avoids other dogs” ($p = 0.0001$) and “Dog behaves submissively when greeting other dogs” ($p = 0.001$) with small breeds having higher fear caused by other dogs

compared to the large breeds. No significant difference was observed on the other questions of fear caused by other dogs among large and small breeds ($p > 0.05$). There was no significant difference in fear caused by human between large and small breeder dogs ($p > 0.05$). About separation behavior, significant difference was seen in questions “Bark or howl when owner is out of the house only”

Table IX. The factor structure of the consensus questionnaire. After each item, the name of the original trait that item belonged to are shown in parenthesis. Loadings greater than 0.3 are shown in bold. Asterisk indicates reversed scored item.

Questionnaire items	Neuroticism	Fear caused by other dogs	Fear caused by human	Separation behavior
Dog easily gets nervous (neuroticism/emotional reactivity)	0.391	0.347	0.545	0.161
Dog remains calm in tense conditions* (neuroticism/emotional reactivity)	0.747	0.057	0.31	0.095
Dog is emotionally stable, not easily upset* also relaxed, handles stress well* (neuroticism/emotional reactivity)	0.495	0.132	0.583	0.138
Dog usually appears relaxed* (negative activation)	0.787	0.037	0.198	0.23
Dog seems nervous and/or jumpy for several minutes after it has been startled (negative activation)	0.438	0.244	0.507	0.143
Dog looks calm in unfamiliar environments* (negative activation)	0.647	0.239	0.474	- 0.061
Dog looks calm in crowded and noisy places* (negative activation)	0.662	0.291	0.409	0.145
Dog is anxious (fearfulness)	0.735	0.093	0.523	0.076
Dog adapts easily to new environment and conditions* (fearfulness)	0.431	0.13	0.611	0.005
Dog gets anxious or fearful in response to sudden or loud noises (non-social fear)	0.764	0.261	0.087	- 0.04
Dog gets anxious or fearful during thunderstorms (non-social fear)	0.667	0.234	0.174	- 0.145
Dog gets anxiously or fearfully when faced by an unfamiliar dog of small, same or larger size (social fear)	0.083	0.861	0.198	0.05
Dog gets fearfully or anxiously when barked, growled or lunged at by an unfamiliar dog (social fear)	0.034	0.871	0.237	- 0.009
Dog behaves fearfully towards other dogs (fearfulness)	0.101	0.822	0.106	0.196
Dog gets anxiously or fearfully when unfamiliar dogs comes to your home (social fear)	0.292	0.861	0.192	- 0.105
Dog avoids other dogs (fearfulness)	0.236	0.699	0.427	- 0.18
Dog behaves submissively (e.g., rolls over, avoids eye contact, licks lips) when greeting other dogs (fearfulness)	0.376	0.711	0.021	0.03
Dog gets fearfully or anxiously when an unfamiliar person attempts to touch it (social fear)	0.112	0.025	0.914	- 0.044
Dog acts fearfully or anxiously when faced by an unfamiliar person in the outside (social fear)	0.356	0.184	0.833	- 0.034
Dog behaves fearfully towards unfamiliar people (fearfulness)	0.143	0.337	0.848	0.002
Dog acts anxiously or fearfully when unfamiliar persons visit your home (social fear)	0.362	0.335	0.687	0.027
Dog barks or howls when owner was out of the house (separation problem)	0.156	- 0.023	- 0.027	0.93
Dog displays howling, whining and/or barking when left on its own (separation-related behavior)	0	0.05	0.034	0.926
Dog displays restlessness, agitation or pacing; scratch, chew or destroying the doors, floor, windows and curtains when left on its own (separation-related behavior)	0.02	0.025	0.055	0.886
Variance (%)	20.81	19.44	21.48	11.57

Fear caused by other dogs = Fear when a dog face with another dog; Fear caused by human = A fear when a dog face with a stranger.

Table X. The outcome of the secondary higher-order PCA using the (a) traits of the consensus questionnaire and (b) the original 4 traits in Iranian dogs. Loadings greater than 0.3 are shown in bold.

	Component 1 fear-related behavior	Component 2 separation-related behavior
Neuroticism (Gosling <i>et al.</i> 2003, Temesi <i>et al.</i> 2014)	0.392	0.009
Fear caused by other dogs (Temesi <i>et al.</i> 2014)	0.934	0.000
Fear caused by human (Jones 2008, Hsu and Sun 2010)	0.897	0.004
Separation behavior (Hsu and Serpell 2003)	0.001	0.996

Fear caused by other dogs = Fear when a dog face with another dog; Fear caused by human = A fear when a dog face with a stranger.

Table XI. The score and *P* values of the consensus questionnaire with fear-related factors based on the Iranian dogs breed category (Small, Large).

Questionnaire items	Breed category	Never	Seldom	Sometimes	Usually	Always	χ ²	P value
Neuroticism								
Dog easily gets nervous (neuroticism/emotional reactivity)	Large	0	8	14	4	2	2.34	0.674 ^{ns}
	Small	4	31	67	34	12		
Dog remains calm in tense conditions* (neuroticism/emotional reactivity)	Large	12	7	1	6	2	5.962	0.202 ^{ns}
	Small	47	36	30	31	4		
Dog is emotionally stable, not easily upset* also relaxed, handles stress well* (neuroticism/emotional reactivity)	Large	2	13	9	2	2	2.188	0.701 ^{ns}
	Small	11	58	43	27	9		
Dog usually appears relaxed* (negative activation)	Large	10	10	6	2	0	2.985	0.56 ^{ns}
	Small	38	46	38	22	4		
Dog seems nervous and/or jumpy for several minutes after it has been startled (negative activation)	Large	0	12	10	2	4	9.153	0.057 ^{ns}
	Small	7	35	56	38	12		
Dog looks calm in unfamiliar environments* (negative activation)	Large	8	5	10	3	2	11.441	0.022 [*]
	Small	19	59	27	25	18		
Dog looks calm in crowded and noisy places* (negative activation)	Large	5	16	5	1	1	10.073	0.039 [*]
	Small	21	46	36	32	13		
Dog is anxious (fearfulness)	Large	8	12	4	4	0	2.764	0.429 ^{ns}
	Small	50	41	24	33	0		
Dog adapts easily to new environment and conditions* (fearfulness)	Large	9	11	6	2	0	4.802	0.308 ^{ns}
	Small	24	62	38	22	2		
Dog gets anxious or fearful in response to sudden or loud noises (non-social fear)	Large	4	7	8	6	3	5.76	0.218 ^{ns}
	Small	6	31	41	49	21		
Dog gets anxious or fearful during thunderstorms (non-social fear)	Large	8	11	2	4	3	8.806	0.066 ^{ns}
	Small	16	51	28	38	15		
Fear caused by other dogs								
Dog gets anxiously or fearfully when faced by an unfamiliar dog of the small, same or larger size (social fear)	Large	8	7	1	4	8	7.389	0.117 ^{ns}
	Small	26	32	31	32	27		
Dog gets fearfully or anxiously when barked, growled or lunged at by an unfamiliar dog (social fear)	Large	9	8	1	3	7	15.046	0.005 ^{**}
	Small	14	39	38	24	33		
Dog behaves fearfully towards other dogs (fearfulness)	Large	13	11	2	0	2	18.773	0.001 ^{**}
	Small	25	44	35	27	17		
Dog gets anxiously or fearfully when unfamiliar dogs comes to your home (social fear)	Large	9	3	3	5	2	2.241	0.692 ^{ns}
	Small	24	12	14	12	2		
Dog avoids other dogs (fearfulness)	Large	18	4	2	4	0	31.949	0.0001 ^{**}
	Small	23	42	39	38	6		
Dog behaves submissively (e.g., rolls over, avoids eye contact, licks lips) when greeting other dogs (fearfulness)	Large	14	4	4	6	0	15.642	0.001 ^{**}
	Small	30	50	50	18	0		
Fear caused by human								
Dog gets fearfully or anxiously when an unfamiliar person attempts to touch it (social fear)	Large	8	13	5	0	2	7.376	0.117 ^{ns}
	Small	49	44	18	24	13		
Dog acts fearfully or anxiously when faced by an unfamiliar person in the outside (social fear)	Large	14	7	3	4	0	4.385	0.356 ^{ns}
	Small	49	43	1	28	11		
Dog behaves fearfully towards unfamiliar people (fearfulness)	Large	14	5	5	4	0	9.091	0.059 ^{ns}
	Small	37	44	40	17	10		
Dog acts anxiously or fearfully when unfamiliar persons visit your home (social fear)	Large	15	6	1	4	2	5.301	0.258 ^{ns}
	Small	53	34	26	19	16		
Separation behavior								
Dog barks or howls when owner was out of the house (separation problem)	Large	15	5	4	2	2	12.532	0.014 [*]
	Small	33	49	33	25	8		
Dog displays howling, whining and/or barking when left on its own (separation-related behavior)	Large	16	6	2	2	2	15.507	0.004 ^{**}
	Small	34	49	31	28	6		
Dog displays restlessness, agitation or pacing; scratch, chew or destroying the doors, floor, windows and curtains when left on its own (separation-related behavior)	Large	18	0	2	8	0	18.994	0.001 ^{**}
	Small	82	36	18	10	2		
Fear caused by other dogs = Fear when a dog face with another dog; Fear caused by human = A fear when a dog face with a stranger; *P < 0.05; **P < 0.001; ns = Non-significant								

($p = 0.014$), "Dog displays howling, whining and/or barking when left on its own" ($p = 0.004$) and "Dog displays restlessness, agitation or pacing; scratch, chew or destroying the doors, floor, windows and curtains when left on its own" ($p = 0.001$) with small breed being more sensitive to separation behavior in comparison to large breed.

Discussion

It has been estimated that behavioral problems are the leading cause of premature death, or relinquishment, among pet dogs, more than those that succumbing to infectious, neoplastic, and metabolic diseases combined. The existence of behavioral problems, such as fear, are likely to decrease dogs' quality of life and may be a reflection of an inappropriate environment (Normando *et al.* 2019). Based on primary purpose of this study, we assessed stress-related factors including neuroticism, fear caused by other dogs, fear caused by human and separation behavior in dogs in Iran. According to the results, neuroticism, fear caused by other dogs, fear caused by human and separation-related behavior were most significant in evoking fear in dogs in Iran. This was similar to previous report by Temesi and colleagues (Temesi *et al.* 2014). The neuroticism aims to measure fear as an individual tendency which had 11 questions and among them "dog usually appears relaxed" and "dog gets anxious or fearful in response to sudden or loud noises" had the highest correlation with neuroticism which can be used for noise phobia (Hsu and Serpell 2003, Jones 2008). Fear caused by other dogs and human is used for dogs' tendency to behave in a certain way in these specific social contexts (Jones 2008, Hsu and Sun 2010). Social fear was divided into fears caused by human and other dogs (Hsu and Serpell 2003).

In the current study, fear caused by other dogs typically affected by "dog gets anxiously or fearfully when faced by an unfamiliar dog of the small, same or larger size", "dog gets fearfully or anxiously when barked, growled, or lunged at by an unfamiliar dog" and "dog gets anxiously or fearfully when unfamiliar dogs come to your home". Additionally, "dog acts fearfully or anxiously when an unfamiliar person attempts to touch the dog", dog acts fearfully or anxiously when faced by an unfamiliar person while away from home" and "dog behaves fearfully towards unfamiliar people" were highly correlated with fear caused by human. Both, fears caused by human and dogs were similar to the previous reports (Hsu and Serpell 2003, Hsu and Sun 2010, Temesi *et al.* 2014). The fact remains that dogs are frequently relinquished because their owners consider their behavior undesirable. In a city like Tehran where

most people live in apartments and with some cultural limitations, many behaviors such as barking and jumping up could be considered unacceptable for owners and their neighbors (Tamimi *et al.* 2013). The separation-related behavior was dissimilar from fear (Hsu and Serpell 2003, Hsu and Sun 2010). The separation behavior items affected with "bark or howl when owner out of the house only", "dog displays howling, whining and/or barking when left on its own" and "dog displays restlessness, agitation or pacing; scratch, chew or destroying the doors, floor, windows and curtains when left on its own" were in agreement to Hsu and Serpell (Hsu and Serpell 2003), Blackwell and colleagues (Blackwell *et al.* 2008) and Temesi and colleagues (Temesi *et al.* 2014). The high prevalence of separation-related behaviors may be caused by insufficient interaction of dogs with other people and the lack of an appropriate walking schedule. Human contact has been shown to decrease cortisol levels and improves the behavior of dogs (Menor-Campos *et al.* 2011).

In order to determine relationship between the different aspects of fear, the PCA was performed. The PCA is mostly used as a tool in exploratory data analysis and for making predictive and "best fitting" models. PCA is the simplest of the true eigenvector-based multivariate analyses. It is closely related to factor analysis (Pasini 2017). The neuroticism caused by other dogs and the human detected as primary factor for fear while separation-related behavior determined as second fear related factor was in agreement with previous reports (Hsu and Serpell 2003, Blackwell *et al.* 2008, Hsu and Sun 2010, Temesi *et al.* 2014). It seems separation-related behavior may emerge without the necessity to have a general fearful attitude than other factors and it is better to look at specific fear-eliciting factors (Temesi *et al.* 2014). Because of social ties developed among humans and dogs, this relationship manifests a very special case. Additionally, family dogs live in a mutual relationship with their human companions. Also, similar to human infants, dogs have stress-related behaviors after separations from the owners (Konok *et al.* 2011). Owners of dogs with separation-related disorder complain about destructive behavior displayed at home or excessive vocalization as well as cognitive bias in an ambiguous choice task (Mendl *et al.* 2010). Despite several questionnaires are used in the veterinary practice to measure separation behavior in dogs, because of variations on dogs' response for separation, there is no fully valid questionnaires for behavior tests. Thus, screening the greeting behavior is the most preferred (Konok *et al.* 2011).

A significant difference was observed between large and small breeds on fear-related factors, which small breeds were calmer in unfamiliar, crowded, and noisy environments. Also, small breeds had

higher fear caused by other dogs compared to large breeds. In our study, 30.7% of owners were men and 69.3% were female. There was no significant difference in fear caused by human between large and small breed dogs. We assumed that dog owners had good cooperation with their pet. However, the study by Temesi and colleagues (Temesi *et al.* 2014) revealed that female owners were more frequently reporting fear caused by human in their dogs. About separation behavior, small breeds were more sensitive to separation behavior in comparison to large breeds. The size of dog is also an important factor, as previously mentioned, small breeds seem to be more anxious, neurotic and fearful (Ley *et al.* 2009, Arhant *et al.* 2010).

It should be noticed that it is difficult to ascertain the social relationship of family dogs with humans and other dogs. It may be useful in the determination of humans and dogs at the individual level, because the intra-specific and inter-specific interactions take place under different conditions (Temesi *et al.* 2014). On the other hand, regional, ethnic, and socioeconomic differences can influence risk factors both in the dogs and in owners (Wan *et al.* 2009). According to the second goal of the current research, we determined the difficulties of dog keeping at home in Iran as an Islamic country. So, we provided three questions as "Impact of rules and prohibitions on access of your dog to outdoor", "Are family members satisfied with dog keeping at home?" and "Do neighbours complain about dog keeping?" to conclude the possible impact of condition on stress-related factors.

Based on the owner's response, 63.6% of them confirmed the rules and prohibitions have a high impact on access of the dog to outdoor. Furthermore, dogs kept in apartments with no access to a yard were more likely to show signs of behaviors that may somehow relate to fear and anxiety. These included fearfulness, phobia-associated behaviors, sleeping disorders, and separation-related behaviors. On the other hand, dogs having access to yards were more likely to show aggressive behaviors and excessive barking. Also it has been reported that dogs with access to outdoor areas had less fear and more aggressive behaviors toward people and other dogs (Khoshnegah *et al.* 2011). Herein, 84.1% of dogs were small breeds and 48.9% were female. For instance, Temesi and colleagues (Temesi *et al.* 2014) have reported that female dogs show a higher level of fear caused by other dogs and our result was similar to this report. It should be noted that large-breed dogs were more likely to live in houses with access to yards (Khoshnegah *et al.* 2011). Accordingly, whether the breed of dogs themselves, having access to a yard, influenced our results, remains to be determined. Breed-associated risk for behavior problems is associated with the

breed distribution in the geographic area (Reisner *et al.* 2005) and the popularity of the breed, but this applies for any risk, that must be calculated with respect to the population (Svartberg 2006). Martinez and colleagues (Martinez *et al.* 2011) reported that increasing body size was also related to a reduced emotion of fear.

The majority of dog owners (81.8%) reported that their neighbors had no complaint about dog keeping. Moreover, 97.7% of the dog owners reported that family members were satisfied with dog keeping at home. For this reason, Tamimi and colleagues (Tamimi *et al.* 2014) modified C-BARQ questionnaire to Persian version of C-BARQ which may represent an effective tool for evaluating the behavior of dogs in Iran. Only three reports have been done to determine stress-related factors in dogs in Iran and based on their reports, prevalence of some of these undesirable behaviors were different between two surveys (Khoshnegah *et al.* 2011, Tamimi *et al.* 2013). We assumed that the differences in fear-related factors in dogs in Iran compared to the other reports might be related to several factors. At first, absence of organized shelters in Iran, the exact number of dogs that are relinquished due to behavioral problems is unknown (Tamimi *et al.* 2014). Secondly, Iranian people may not be good at recognizing signs of fear in their dogs as reliance on questionnaires (Tamimi *et al.* 2014). Lack of exposure (e.g., little interaction of Iranian dogs with other animals and people, lack of an outdoor walking schedule) may contribute finding (Tamimi *et al.* 2013). There are very few professional dog trainers in Iran and there is no tendency to train dog by owners. Also, dogs are infrequently neutered/spayed in Iran (Khoshnegah *et al.* 2011, Tamimi *et al.* 2014). Cultural and legal challenges faced by dog owners in Iran may have affected dog ownership. Dogs are not popular as companion animals in Iranian culture. Moreover, because many dog owners have disagreements with their own family members or neighbors about keeping dogs, they tried to keep the dog quiet and invisible which affects relationships with dogs (Khoshnegah *et al.* 2011, Tamimi *et al.* 2013, Tamimi *et al.* 2014). So, it seems the rules and prohibitions in Islamic country have a high impact on access of the dog to outdoor. Also, despite no complaints of neighbors reported for keeping dogs in this study, we think sample size, difficulties to access to all neighbors and religious prohibitions are the main limitations of the current study and more studies with higher sample size are needed.

When presented with threatening stimuli, physiological mechanisms are triggered within the body to prepare for action and animals generate appropriate behavioral responses. Cortisol is the main physiologic indicator of stress in dogs and its circulating levels is a useful indicator to determine

animal welfare and stress-associated behavior (Ng *et al.* 2014). Based on the limitation of the current study, we were not able to determine the cortisol levels in dogs. So, it is suggested to determine serum cortisol level following the assessment of fear-related behavior using questionnaires in dogs. In conclusion, the findings of this study indicate the legal restrictions have important effect on the fear of dogs. The different aspects of fear sign the PCA test revealed neuroticism, fear caused by other dogs and human loaded on the 1st factor while separation-related behavior separated in the 2nd factor. Bearing in mind that these results represent a small population of dogs in Tehran, it is highly recommended that more

comprehensive studies need to be done to further evaluate the behavioral problems of dogs in Iran. Further studies are needed to understand the effect of these limitations on other behavioral problems as well as to assess whether and how these limitations have affected the relationship between dogs and their owners in Iran.

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