Investigations on the incidence of deafness in Van cats and its distribution by eye color

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ARTICLE INFO

Article History
Received : 12.08.2021
Accepted : 28.01.2022
DOI: 10.33988/auvfd.975163

Keywords
Deafness
Incidence
Van cat

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How to cite this article: Almaç Çelik F, Kaya A (2023): Investigations on the incidence of deafness in Van cats and its distribution by eye color. Ankara Univ Vet Fak Derg, 70 (2), 203-212. DOI: 10.33988/auvfd.975163.

ABSTRACT

This study aims to demonstrate the incidence of deafness in Van cats and its distribution by eye color. A total of 300 Van cats aged between 2 months and 8 years were classified into three separate groups (equal in number) subjected to hearing tests using Clinical ABR (Auditory Brain Response) device. In this study, the incidence of deafness in Van cats was found to be 14.33%. Moreover, it was determined that deafness was not related to sex and hair length. Van cats with spots on their heads did not have deafness. The hearing thresholds showed that most Van cats had a very good level of hearing (0-10 dB nHL). The incidence of unilateral deafness was much lower in Van cats than it was in other white cat breeds. By means of this study, the breeding of the cats found to be deaf according to the results of ABR test will be prevented, and in this way we believe that the incidence of deafness in Van cats will decrease in future. This study is the first deafness study conducted in Van cats and it is worth to present as the findings of the study will shed light on future studies.

Introduction

Cats are good models for deafness studies because they can hear low frequency sounds like humans, and making it possible to evaluate the incidence of deafness in them (19). In cats deafness is often caused by a genetic disorder. It has long been known that congenital deafness is common in white cats with blue eyes (24). Owing to genetic factors Van, Ankara and other white cat breeds show the presence. Deafness which has been determined to be associated with the White (W) gene that is responsible for producing white fur in these cats (25).

Two dominant genes, W and White spotting (S), are responsible for the white color. The W gene, which is found in many cat species, is an autosomal dominant gene and not found to be associated with albinism. Cats carrying the W gene are completely white and some have spots on their heads that disappear with age. Furthermore, the prevalence of deafness is high in white cat populations carrying the W gene (19, 22). The W gene is pleiotropic and white coats, blue iris and deafness, all three effect of the W gene are reported to be associated with the absence or abnormality of melanocytes (19). Additionally, hereditary sensorineural deafness is associated with the W pigment gene (6). Cats may have blue eyes even though they do not have the W gene. This is caused by the Siamese (c^s) pigment gene and it is reported that this gene does not lead to deafness (23). Another reason for white fur in cats is the S gene called Piebald. According to reports, this gene is also not associated with deafness (6).

Certain melanocyte populations in the inner ear are essential for hearing, and absence of functional melanocytes will lead to deafness and changes in the pigment. Melanocytes are produced from the neural crest and located in the cochlear region called the stria vascularis which is rich in blood vessels. In the absence of melanocytes in the inner ear, the stria vascularis typically does not undergo development and acquire functionality. Thus, cochlear hair cells as well as auditory neurons degenerate, resulting in congenital deafness and changes in the pigment of the iris and the fur (16).

The best objective evaluation of deafness can be performed using the Auditory Brainstem Response (ABR). ABR is evoked by sound, is a non-invasive and records the electrical activity that occurs in the auditory pathways in response to click-like sound impulses via electrodes placed on the scalp (4, 14, 22). It is an accurate and reproducible method for assessing deafness in dogs and cats. It provides valuable information on treatment protocol and prognosis and distinguishes conductive and sensorineural deafness (3). Since ABR is affected by movement, the tests are usually performed during sleep, under sedation or general anesthesia (10). To record ABR, a "click" sound is sent to the ear, consequently, 4-7 characteristic waves are formed in the brain in response to the stimulus. Each of these waveforms, expressed in Roman numerals, is related to a specific structure or region within the auditory canal (27). For diagnostic purposes, wave crests I, III and V are evaluated and it has been reported that the wave V, which is the largest peak in individuals with normal hearing, is the most emphasized component in clinical practice (8, 9).

The Van cat is one of the most important cat species in the world. However recently, it has been decreasing in number and therefore, is under protection. The Van cat, highly valuable to Türkiye and the province of Van, is known for its different eye colors, friendliness, white and silky fur and interest in water (7, 11). All scientific studies conducted on Van cats would contribute toward a better understanding of this breed, reveal its difference from other cat breeds, determine its reference values, and lead to a better understanding of its value in Türkiye and in the world. Although many studies on deafness have been conducted for white cats in Türkiye and in the world, the absence of scientific studies on the incidence of deafness in Van cats and its relationship with eye color, gender, hair length and spots on the head has encouraged us to perform this study.

Therefore, the purpose of this study is to demonstrate the incidence of deafness in Van cats with one blue and one amber eye, two blue eyes, and two amber eyes, and the relationship of deafness with eye color, sex, hair length and spots on the head.

Materials and Methods

This study included 300 male and female Van cats [cats with two blue eyes (n = 100), two amber eyes (n = 100) and one blue eye and one amber eye (n = 100)] of 2 months-8 years in age having no health problems as per screening test results and located at the Van Yüzüncü Yıl University Van Cat Research and Application Center within the borders of the Van province. A Clinical ABR device (*Otometrics ICS Chartr Ep 200*) was used to determine the hearing status of the cats. It is reported that the ear canal of cats and dogs do not open immediately after birth but open 3–4 weeks later, therefore, tests performed at earlier ages are not reliable (22).

Cats to be tested were kept under fasting conditions for 12 h. The cats determined to be that healthy based on general examination result were anesthetized using atropine (0.06–0.1 ml/4 kg), xylazine (0.1 ml/kg) and ketamine (0.1 mg/kg). Electrodes and headphones were prepared while the cats were under anesthesia. For disinfection, the electrodes were first disinfected with povidone-iodine solution, then zefiran was used and the electrodes were dried with sterile gauze. Care was taken so that the electric and headphone cables did not touch each other. The description of the cat to be tested was entered on the ABR device. Once the cats were anesthetized, they were placed on their chest, and electrodes were subcutaneously placed in the area surrounding the right and left mastoid bones of the cats, and on the front and base of the neck (Figure 1). Disposable insert headphones suitable for cat ears were used for performing the hearing test. Although the ABR device had the capacity to mask ambient sounds, an environment that was quiet and free of external stimuli was created for the test.

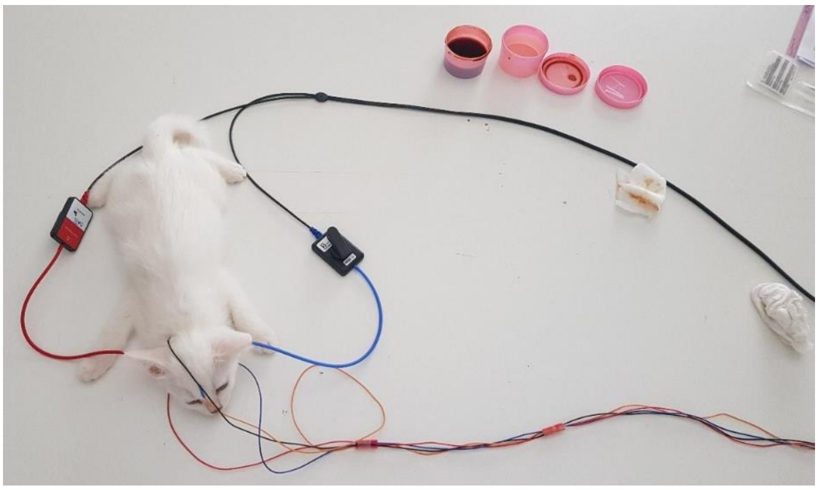

Figure 1. Electrode and headphone placement in a Van cat undergoing ABR testing.

DOI: 10.33988/auvfd.975163

First, 1000 click stimuli with an intensity of 50 dB nHL were sent to the ear of the cat under test. If the wave V was detected at this sound intensity, the sound intensity was decreased, and a click stimulus with an intensity of 30 dB nHL was sent. Similarly, if the wave V was detected at this sound intensity, the sound intensity was decreased to 10 dB nHL this time. If the wave V was detected once again, the last click was sent with a 0 dB nHL intensity, and the graphics were recorded. If there was no wave V at an intensity of 50 dB nHL, a click stimulus with an intensity of 70 dB nHL was sent. If there was no wave V, the sound intensity was increased to 90 dB nHL, and the click stimulus was sent again (Figure 2, 3, 4, and 5). Thus, the hearing threshold of the cat was determined (Table 1).

Table 1. Classification based on the audiological findings of Van cats.

Hearing loss range	Degree of hearing loss
≤30 dB nHL	Normal hearing
50–70 dB nHL	Moderate hearing
70–90 dB nHL	Poor hearing
>90 dB	No hearing

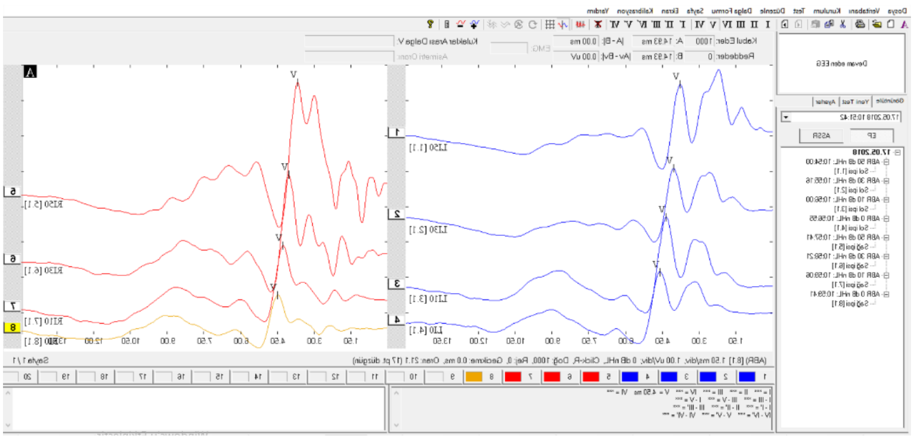

Figure 2. ABR performed for the right and left ears of a Van cat with two blue eyes and unimpaired hearing function (0, 10, 30, and 50 dB nHL).

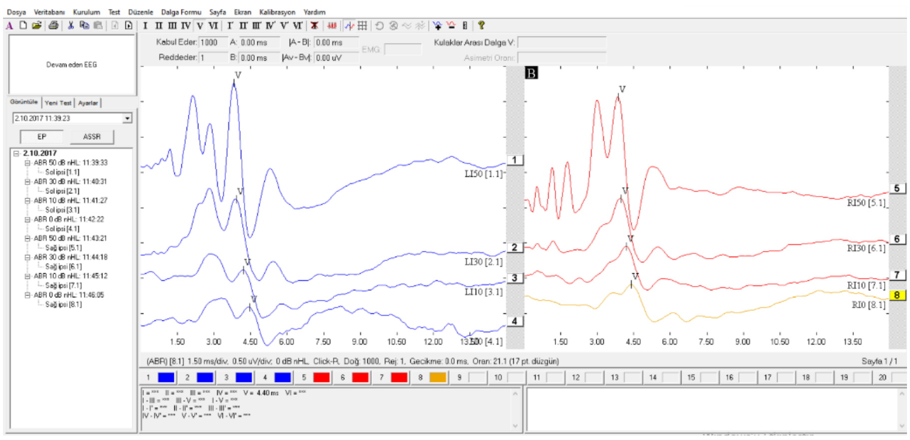

Figure 3. ABR performed for the right and left ears of a Van cat with two amber eyes and unimpaired hearing function (0, 10, 30, and 50 dB nHL).

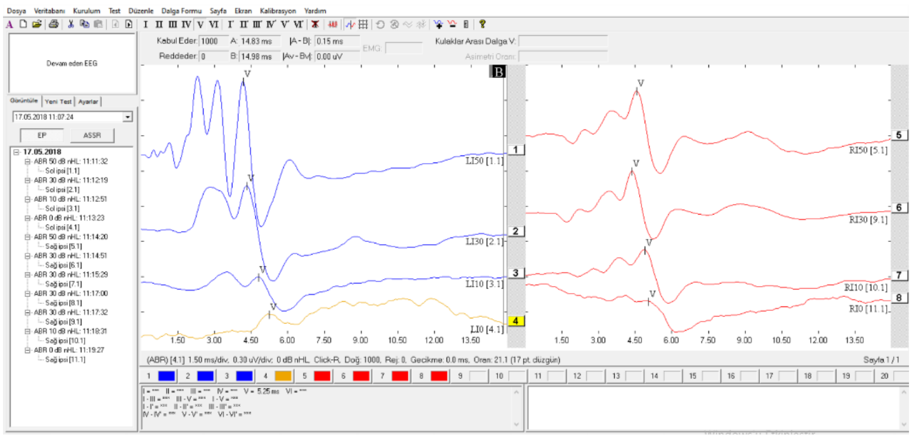

Figure 4. ABR performed for the right and left ears of a Van cat with one amber and one blue eye and unimpaired hearing function (0, 10, 30, and 50 dB nHL).

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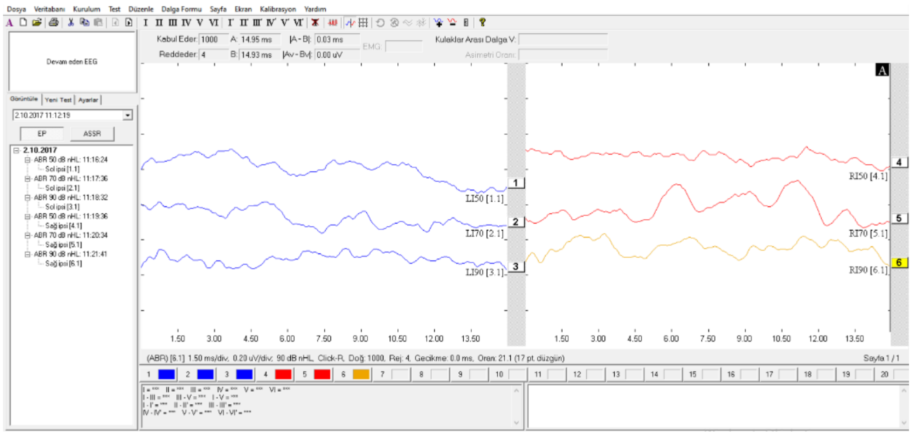

Figure 5. ABR performed for the right and left ears of a deaf Van cat with one amber and one blue eye (50, 70, and 90 dB nHL).

Statistical analysis: Descriptive variables were expressed as mean, and standard deviation, continuous as minimum and maximum values and categorical variables as number and percentage. One-way analysis of variance was used for comparing the groups in terms of continuous variables. Pearson correlation coefficients were calculated to determine the relationship between continuous variables. Chi-square test and multiple correspondence analysis were used to determine the relationship between the groups and categorical variables. Additionally, logistic regression analysis was performed to determine the variables that may have an effect on deafness. Furthermore a statistical significance level 5% was considered, and the SPSS (ver: 21) statistics package software was used for calculations.

Results

No health problems were reported in the routine clinical examination result of the animals included in the study. Body temperature and respiratory and pulse rates were within the normal reference ranges reported for cats.

Considering the relationship of hearing function with age, weight, body temperature, pulse and respiration, it was shown that the relationship of these parameters with deafness was statistically insignificant (Table 2).

The hearing thresholds of the cats subjected to the ABR test were found to be different. Of the cats included (n = 300), 62% (n = 186) reponded to the 0–10-dB nHL sound stimuli sent in the right ear, 18% (n = 54) reponded to the 30–50-dB nHL range, and 5.35% (n = 17) reponded to the 70–90-dB nHL range. Furthermore, 14.33% (n = 43) cats did not show wave V responses for sounds > 90 dB nHL. For the left ear, 63% (n= 190) cats showed wave V response for sounds between 0 and 10 dB nHL, 14.33% (n= 43) for sounds between 30 and 50 dB nHL, 8% (n= 24) for sounds between 70 and 90 dB nHL, and 14.33% (n= 43) did not show wave V response for sounds > 90 dB nHL (Table 3). With respect to hearing thresholds, there was no remarkable difference between the right and left ears, and the majority of Van cats had very good hearing.

On evaluating the hearing thresholds of the cats (n = 300), it was determined that 17.66% of the cats could hear even at 0 dB nHL. In terms of eye color, of the cats who showed response at 0 dB sound 10 were with two blue eyes, 23 with two amber eyes, and 20 with one blue and one amber eye. Based on this, it was found that the group of cats with two amber eyes and that of cats with one blue and one amber eye had higher numbers of cats with very good hearing compared to the group of cats with two blue eyes.

The rate of deafness in male cats was 53% and that in females was 47%. This showed that male cats had a slightly higher rate of deafness compared to females; however, the difference was not statistically significant (P>0.10) (Table 2 and 4).

In the three study groups that each consisted of 100 female and/or male Van cats, the rate of deafness in Van cats with two blue eyes was 25%, with two amber eyes was 6% and with one blue and one amber eye was 14%. The overall deafness rate was 14.33%. The highest rate of deafness was in those with two blue eyes, and the lowest rate of deafness was in those with two amber eyes. The relationship between hearing status and eye color, was found to have a high level of statistical significance (P<0.001) (Table 2 and 5).

On evaluating the cats in terms of hair length, 17 out of 119 long-haired cats and 26 out of 181 short-haired cats were found to be deaf. When the relationship between short-haired and long-haired cats, was evaluated, it was found to be statistically insignificant (P>0.10) (Table 2 and 6).

Among the three groups (n = 300), unilateral or bilateral deafness was not present in a total of 30 (10%) cats with black spots on their heads. The relationship between the presence of spots and hearing status was statistically significant (P<0.01) (Table 2 and 7).

DOI: 10.33988/auvfd.975163

Table 2. Logistic regression.

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp (B)
Step 0	Constant	-1.788	0.165	117.748	1	0.000	0.167

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	220.575[a]	0.083	0.148

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.
Method = Enter

Variables in the Equation							
		B	St. Hata	Wald	df	P	OR
	Sex (1)	-0.012	0.360	0.001	1	0.972	0.988
	Age month	0.007	0.015	0.217	1	0.642	1.007
	Weight	0.000	0.000	0.171	1	0.679	1.000
	Eye color			9.389	2	0.009	
	Eye color (1)	0.969	0.448	4.679	1	0.031	2.636
	Eye color (2)	-0.608	0.567	1.149	1	0.284	0.544
	Hair (1)	-0.150	0.364	0.170	1	0.680	0.861
	Body temperature	0.438	0.296	2.189	1	0.139	1.550
	Pulse	0.003	0.016	0.033	1	0.856	1.003
	Respiration	-0.017	0.022	0.582	1	0.446	0.983
	Spot (1)	-19.197	7177.001	0.000	1	0.998	0.000
Step 1[a]	Constant	-18.412	11.637	2.503	1	0.114	0.000

Table 3. The hearing threshold of Van cats in study groups.

Hearing threshold (dB nHL)	Hearing classification	Right ear	Left ear	Mean	%
0–10	Very good hearing	186	190	188	62.66
30–50	Good hearing	54	43	49	16.33
70–90	Poor hearing	17	24	21	7
>90	Deaf	43	43	43	14.33

Table 4. Statistical results according to crosstabs: hearing * sex.

			Sex		Total
			Female	**Male**	
Hearing	**Normal**	Count	127	130	257
		% within hearing	49.4%	50.6%	100%
		% within sex	86.4%	85%	85.7%
		% of Total	42.3%	43.3%	85.7%
	Deaf	Count	20	23	43
		% within hearing	46.5%	53.5%	100%
		% within sex	13.6%	15%	14.3%
		% of Total	6.7%	7.7%	14.3%
Total		Count	147	153	300
		% within hearing	49%	51%	100%
		% within sex	100%	100%	100%
		% of Total	49%	51%	100%

Ki-kare=0.124
P=0.724

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Table 5. Statistical results according to crosstabs: hearing * eye color.

			Eye color			Total
			Blue eyes	Amber eyes	Blue-amber eyes	
Hearing	Normal	Count	75	94	88	257
		% within hearing	29.2%	36.6%	34.2%	100%
		% within eye color	75%	94%	88%	85.7%
		% of Total	25%	31.3%	29.3%	85.7%
	Deaf	Count	25	6	12	43
		% within hearing	58.1%	14%	27.9%	100%
		% within eye color	25%	6%	12%	14.3%
		% of Total	8.3%	2%	4%	14.3%
Total		Count	100	100	100	300
		% within hearing	33.3%	33.3%	33.3%	100%
		% within eye color	100%	100%	100%	100%
		% of Total	33.3%	33.3%	33.3%	100%

Ki-kare=15.365
P=0.000

Table 6. Statistical results according to crosstabs: hearing * hair.

			Hair		Total
			Long	Short	
Hearing	Normal	Count	102	155	257
		% within hearing	39.7%	60.3%	100%
		% within hair	85.7%	85.6%	85.7%
		% of Total	34%	51.7%	85.7%
	Deaf	Count	17	26	43
		% within hearing	39.5%	60.5%	100%
		% within hair	14.3%	14.4%	14.3%
		% of Total	5.7%	8.7%	14.3%
Total		Count	119	181	300
		% within hearing	39.7%	60.3%	100%
		% within hair	100%	100%	100%
		% of Total	39.7%	60.3%	100%

Ki-kare=0.000
P=0.985

Table 7. Statistical results according to crosstabs: hearing * spot.

			Spot		Total
			Spotted	Unspotted	
Hearing	Normal	Count	30	227	257
		% within hearing	11.7%	88.3%	100%
		% within spot	100%	84.1%	85.7%
		% of Total	10%	75.7%	85.7%
	Deaf	Count	0	43	43
		% within hearing	0%	100%	100%
		% within spot	0%	15.9%	14.3%
		% of Total	0%	14.3%	14.3%
Total		Count	30	270	300
		% within hearing	10%	90%	100%
		% within spot	100%	100%	100%
		% of Total	10%	90%	100%

Ki-kare=5.577
P=0.018

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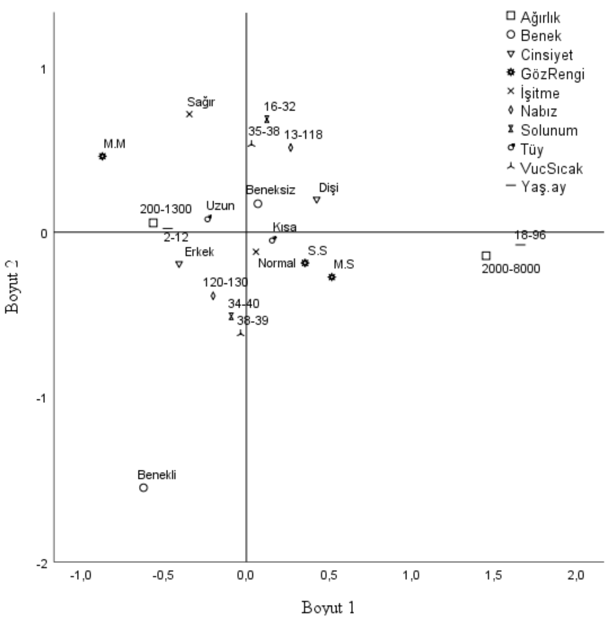

Figure 6. Multiple correspondence analysis.

Multiple correspondence: Based on the multiple correspondence analysis, there was a positive correlation between the rate of deafness and presence of long hair in cats with two blue eyes. The rate of deafness was low in cats with two amber eyes and those with one blue and one amber eye, and male cats were more prone to deafness than female cats, Furthermore, deafness was not observed in cats with spots on their head (Fig. 6).

Discussion and Conclusion

Hearing, which is a physiological process, is one of the most effective means of communication among living things. Hearing loss occurs as a result of the impairment of this process due to pathological reasons and can range from total loss of hearing to a slightest decrease in hearing ability (12, 26).

Deafness in white cats is mostly the result of a genetic disorder (24). It is reported that Ankara, Van, and other white cat breeds are deaf due to genetic factors, and that this condition is associated with the White (W) gene which produces white fur in cats (19, 22). To evaluate the incidence of deafness in the Van cat breed, which is among the pure white cat breeds, the cats must be evaluated first in terms of genetic and other characteristics (1). Although Van cats are shown to be among the white cat breeds in which deafness is common, there is no scientific data regarding the characteristics and incidence of deafness in Van cats. Therefore, the purpose of this study was to demonstrate the incidence of deafness in Van cats and its distribution by eye color using scientific data.

When performing the ABR test, it is important to sedate or anesthetize the animal for ensuring test (10). In one study, intramuscular ketamine HCl and intramuscular acepromazine were administered for sedating the cats to be subjected to the ABR test (17). In a thesis for a study on Angora cats, it was reported that the cats were anesthesized using atropine, xylazine and ketamine for the ABR test (25). In another study, it was reported that mice were anesthetized using intraperitoneal ketamine and xylazine injection before performing the ABR test to determine hearing status (14). However, although it was reported that some clinicians preferred sedation while performing the ABR test, some studies reported that sedation or anesthesia was not required (19). In our study, it was determined that when the anesthesized cats blinked or the cats tails were lifted even slightly, it resulted in the deterioration of the ABR waves. Therefore, it was suggested that the animal to be tested should be under sedation or anesthesia in order to obtain smooth ABR waves and evaluate the results properly, and even though the ABR device has the capacity to mask ambient sounds, the test will yield better result when it is performed in a quiet environment.

Audiometers used in audiological diagnosis are now calibrated according to ISO-1969 standards, taking into account the hearing level (HL). In the calibration of audiometers, instead of the previously; used dB sound pressure level (SPL) the dB HL, which is the lowest sound intensity perceived by the human ear at different frequencies, has been accepted, resulting in the introduction of the concept of audiometric zero (20). The most important component emphasized while evaluating the clinical applications of ABR is the wave V (8). This wave forms the highest peak in an individual with normal hearing, and delay or absence of wave formation may indicate neurological or cochlear defects (2, 9). Considering these data, the dB HL unit was used in the evaluations in our study, and based on the audiological results, cats responding with the wave V at sound levels < 30 dB nHL and between 50-70 dB nHL, and between 70-90 dB nHL had good, moderate and poor hearing respectively. Cats with no response to the click stimulus at sound levels > 90 dB were classified as deaf. In our study, of the total 300 cats included, 188 (62.66%) undergoing the ABR test had very good hearing in the 0–10 dB nHL range, 49 (16.33%) had good hearing in the 30–50 dB nHL range, 21 (7%) had poor hearing in the 70–90 dB nHL range, and 43 (14.33%) were deaf and had no wave V response above 90 dB nHL. This study determined the hearing thresholds of Van cats. And showed that there was no remarkable difference between the right and left ears in terms of hearing thresholds, and the majority of Van cats had very good hearing.

Deafness can be unilateral or bilateral (26). In three simultaneous studies conducted in 1984, the rate of deafness was analyzed in a total of 256 crossbred cat breeds, and it was found that 12.1% of these cats had unilateral deafness, and 37.9% had bilateral deafness. In a thesis for a study on Angora cats, the ABR test was performed in nine cats, of which, seven had unilateral deafness. It was reported that there was no bilateral deafness, and the prevalence of unilateral deafness was 77.7% in Angora cats (25). In another study, the prevalence of deafness was found to be 20.2% based on the results of the ABR test performed in 84 white cats; 9.5% of these cats had unilateral deafness, and 10.7% of them had bilateral deafness. The combined prevalence of unilateral or bilateral deafness in cats was reported to be 44.4%. This rate was 20% in cats with different eye colors and 18.9% in others (6, 24). Furthermore, evidence that the ear on the side of the blue eye is more affected in unilaterally and bilaterally deaf animals has been reported (18). In our study, it was determined that there were 43 cat with bilateral (14.33%, n = 300) deafness and 1 ear of 2 cats among the study groups showed a wave V response to a sound at 0 dB nHL and the other ear at 90 dB nHL. Additionally, the unilateral deafness rate in Van cats was found to be much lower compared to that in other white breed cats.

Based on the ABR test results of a study conducted with white cats, the prevalence of deafness was reported to be 20.2%. This study revealed that deafness was not associated with gender (6, 24). Based on the statistical evaluations conducted in our study, it was revealed that the relationship between gender and deafness was not significant (P>0.10). However, based on the multiple correspondence analysis, it was determined that male Van cats may be more prone to deafness. These results are consistent with the literature (Figure 6).

The most common locus that produces long hair in mammals is the *Long (L)* locus, which is controlled by *fibroblast growth factor-5 (FGF-5)* and the most important factor for cat hair length (15). It was suggested that the rates of deafness and having blue eyes were higher in long-haired cats compared to short-haired cats; however no related evidence was reported (22). In our study, it was revealed that the relationship between deafness and hair length was statistically insignificant (P>0.10). On performing multiple correspondence analysis, it was determined that long-haired blue-eyed Van cats may be more prone to deafness (Figure 6), and the data obtained are consistent with the literature.

Deafness can occur congenitally or later after birth (22, 26). Congenital deafness is more common in blue-eyed white cats. Charles Darwin stated in a book that he wrote in 1868 that blue-eyed cats were mostly deaf. He reported that the eyes of these cats were blue due to the lack of melanocytes, and the rate of deafness in blue-eyed cats was approximately 80% (19, 22). Deafness was analyzed in a total of 256 crossbred white cat breeds in three simultaneous studies conducted in 1984; two of these studies examined the effect of blue eye on deafness. It was reported the rate of deafness in cats with two blue eyes was 64.9%–85%, and it was 39.1%–40% in those with one blue eye and 16.7%–22% in those without blue eyes (21). Another study investigated whether there was a gene responsible for deafness in blue eye and reported that the rate of deafness in the experimental colony was 67%. Bivariate analysis results showed that polygenic effects could also have played an important role in addition to the effect of the main gene (22). Based on the results of the ABR test performed in 84 white cats, the rate of deafness in blue-eyed cats was found to be higher than that in others (6, 24). In a thesis study conducted on Angora cats, the ABR test was performed in a total of 9 cats; of which 5 two blue eyes and 2 different eye colors, and it was reported that unilateral deafness was not correlated with eye color and gender (25). It is widely accepted that there is a relationship between deafness and animal pigmentation (5). A study tested hearing function in dog breeds at risk of pigment-related congenital sensorineural deafness and found that deafness in English Setter and English Cocker Spaniel dogs was associated with blue eye, and deafness was more common in white Bull Terriers than in colored Bull Terriers (22). It was also shown that the risk of being prone to congenital sensorineural deafness was higher in blue-eyed Dalmatian dogs compared to brown-eyed dogs (13). In a study conducted on 1031 Dalmatian dogs, a positive relationship was found between deafness and having one or two blue eyes or not having pigments in the tapetum lucidum. This relationship was also demonstrated in other dog breeds and white cats (22). There was a positive correlation between deafness in the offspring of those with unilateral or bilateral deafness in one or both parents. Another study showed that there was a positive correlation between blue eye color and deafness, and that blue-eyed cats were more prone to deafness than amber-eyed cats those with different eye colors (6, 24). In our three study groups (n_{total} = 300), the rate of deafness in Van cats with two blue eyes was 25%, and it was 6% in those with two amber eyes and 14% in those with one blue and one amber eye. The mean deafness rate for all the three groups was 14.33%. Our study found that 43 out of 300 cats were deaf. Based on these data, the highest rate of deafness was found in Van cats with two blue eyes and the lowest rate of deafness was in those with two amber eyes. Furthermore, the relationship between eye color and deafness was determined to be highly significant (P<0.001). These data support the view in the literature that deafness is more common in cats with two blue eyes and less common in cats with two amber eyes and those with different eye colors in both the eyes (21). It was demonstrated that the incidence of deafness in Van cats was lower compared that in other pure white cat breeds of the same category.

DOI: 10.33988/auvfd.975163

White cats are among the animal species in which congenital deafness is common. It has been found that this is associated with the White (W) gene which is responsible for producing white fur in cats (19, 22). Cats carrying the W gene are not always completely white, and some may have colored spots on their heads that disappear with age. It is reported that if a white kitten has even a small amount of discoloration (a speck or spot), this significantly reduces the likelihood of deafness in the cat. Having spots is an indication that the cat has more functional melanocytes (albeit few) than non-spotted cats. It has been reported in the literature that deafness is less common in animals with spots (19, 22). In our study on Van cats, unilateral or bilateral deafness was not found in 30 (10%) cats with black spots on the head in all three groups. This result is consistent with the literature.

If the genes responsible for deafness are not known and marker tests are not feasible, it is very important to use ABR records to reduce genetic hearing disorders, prevent deaf cats from breeding and develop selection plans. It is reported that breeding cats with hereditary deafness will result in the continuation of defects in the gene pool of the breed, and that the rate of deaf litter will be higher than that of normal litter. Thus, even if only one parent is deaf, the vast majority of the litter will be born deaf and have white fur (25). Therefore, this study is important as it aims to detect deaf cats to help prevent the transmission of deafness to future generations by discontinuing the breeding of deaf animals.

As a result of this study, we believe the breeding of cats evaluated to be deaf on the basis of the ABR test results and located at the Van Cat Research and Application Center; in the province of Van and its surroundings can be prevented. Furthermore, we believe that in future, the incidence of deafness in Van cats will decrease and the deafness rate determined in this study will decrease even more via the discontinuation of the breeding of deaf cats. Our study is very important since, it is the first study on deafness in Van cats and shows the rate of deafness in them.

Acknowledgements

This article is summarized from the doctoral thesis of the same name.

Financial Support

This research received no grant from any funding agency/sector.

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

FAÇ and AK conceived and planned the experiments. FAÇ carried out the experiments. FAÇ and AK contributed to the interpretation of the results. FAÇ took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Ethical Statement

This study was approved by the Van Yüzüncü Yıl University Animal Experiments Local Ethics Committee (dated 02.05.2019 and numbered 2019/04).

Animal Welfare

The authors confirm that they have adhered to ARRIVE Guidelines to protect animals used for scientific purposes.

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DOI: 10.33988/auvfd.975163